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PLANTING NEAR MOUNT HOOD

A typical scene in the Oregon National Forest at the Still Creek Planting Station, showing the ground which has been devastated by fire and which is being planted with young seedling conifers. The rehabilitation of such areas as this means a sure and safe water supply and future timber, as well as picturesque scenery. (Frontispiece.)

CHOOSING THE BEST TREE SEEDS

The Influence of Parental Character and Environment upon the Progeny of Douglas Fir—Study Will Extend Over at Least Forty Years

CHARLES J. KRAEBEL

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THE influence of the character of the parent plant upon the development of the progeny of that plant is a matter of vital importance in plant culture. The influence of the parental habitat as reflected in the seed productivity and seed quality is likewise important, for practical and economic reasons. That both these considerations are regarded in ordinary agriculture is a matter of common knowledge; but ti is not so commonly known that the application of the principles of genetics to the culture of forest trees and to the practical management of forest lands has come to be a necessity of modern forestry.

In the Forest Service this application is required in seed collection for extensive artificial reforestation, and in the choosing of seed trees to be left in logging operations in the National Forests. In reforestation work, great quantities of forest tree seeds are used annually by the government nurseries, and this seed must be harvested within a very short time in the fall. The bulk of it is collected by the Forest Service itself, but much of it must often be purchased from commercial seedsmen. In the past there was no experience in American forestry to serve as a guide in this matter, and the gathering of the seed was therefore controlled by expediency rather than by the principles of genetics. Since large quantities were required quickly, it was natural to collect such seed as was nearest and easiest to obtain. There is good reason for believing that in America, as in Europe, there resulted from this cause occasional fundamental errors in planting, as, for example, the planting in severe sites at high altitudes of plants raised from seed collected on moderate sites at low altitudes. In Europe, particularly in Sweden, the percentage of failures in such plantations was often excessively high, and the failure frequently did not occur until the plantations had reached the age of ten or fifteen years. Guided by that experience, much good can be done in this country by the appropriate disposition of seed the source of which is definitely known. But before it is possible to specify with certainty what sort of seed is best for any particular set of conditions, it is necessary to know something of the influence of the character and environment of the parent tree upon the qualities most desired in its progeny.

EUROPEAN STUDIES

A vast amount of work has been done upon this same problem with European species by the forest experiment stations of Europe. For over twenty years the subject has received the attention of such eminent students as Mayr, Cieslar, Engler, Zederbauer and Huffel. Some work has been undertaken with Douglas fir, from seed obtained through the Forest Service, by Count von Berg, of Livonia, Russia. The work of Professor Engler of Switzerland has been especially exhaustive and productive of practical results with Austrian pine. General principles have been evolved which have been applied, in a measure, to American practice. But for any species of such extensive range and large value as Douglas fir, the only satisfactory procedure is to conduct an individual study for the species, which answers by experimental results the questions which can only be so answered.

The study here described, known as

[1] Mr. Kraebel is now with the 10th Engineers (Forest) in France, and was hence unable to read proof on his article.

GIANT DOUGLAS FIR OF CALIFORNIA

More than eight feet in diameter, the magnificent Douglas fir standing to the immediate right of the track is the type of tree with which tree growers are gradually reforesting the devastated areas. (Fig. 1.)

the Douglas Fir Seed Study, was initiated in the fall of 1912 at the Wind River Experiment Station near Carson, Washington. It will be continued for forty years, or as much longer as it will yield data of value. The data gathered during the first few years are expected to serve primarily as a guide in the collection of seed, and secondarily as an aid in the selection of seed trees to be left standing in timber-sale cuttings. Among the immediate questions to be answered are the following:

1. What class of tree produces the best quality and quantity of seed—young, middle-aged or old; healthy or diseased?
2. What particular qualities of seed are required to produce the most desirable seedlings for artificial reforestation on various sites?
3. What is the influence of locality of the parent tree upon the progeny raised from that tree?

It will be appreciated at once that there are innumerable questions, subordinate to these, which enter the problem but which cannot be discussed in the brief compass of this article.

METHODS

In the fall of 1912, cones were collected from 127 different trees in ten different localities on the west slope of the Cascade Mountains from northern Washington to midwestern Oregon. The classes of trees from which cones were gathered are as follows:

1. (*a*) Very young (14–30 years)
   (*b*) 75–100 years old
   (*c*) 100–200 years old
   (*d*) Old (over 300 years)
   } Open-grown trees at low altitudes.

2. (*a*) Second growth (60, 65 and 100 years)
   (*b*) Old growth (220 and 600 years)
   } Dense-grown trees at low altitudes.

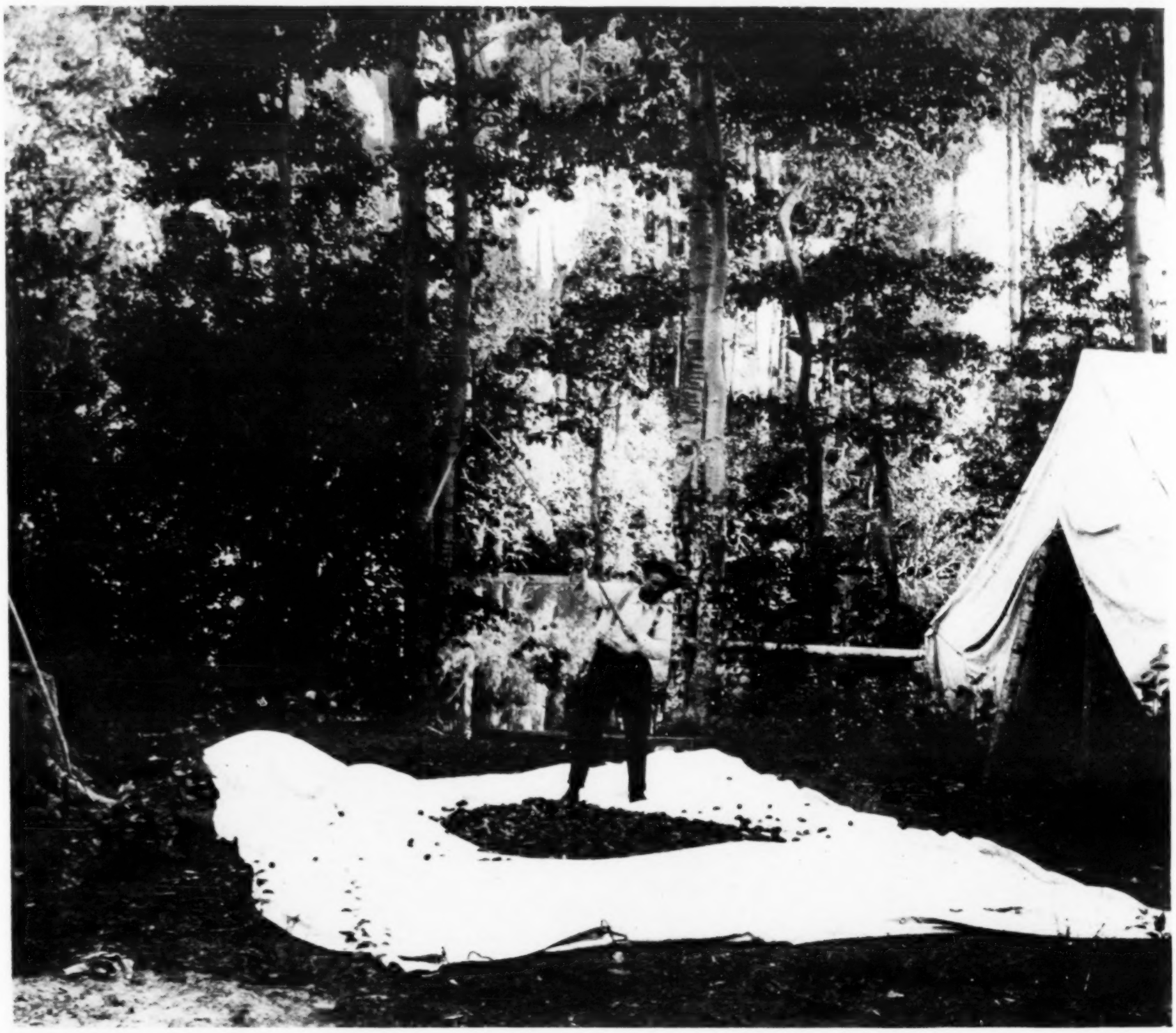
3. (*a*) Second growth
   (*b*) Old growth
   } Trees at high altitudes.

4. (*a*) Young (40 years)
   (*b*) Old (150 years)
   } Trees from Steilicoom Plains { Effect of poor soil.

5. (*a*) Diseased
   (*b*) Sound
   } Trees of middle age (275–400 years).

The altitudes of the sites varied from 100 to 3,850 feet above sea-level. The trees ranged in age from fourteen years to 600 years, and, in size, from a diameter of 3½ inches to 6½ feet. The trees were carefully chosen for the desired qualities, and for each condition several trees were used in order to minimize the likelihood of disturbance through the possible erratic qualities of some individual tree. By this means a group of four to ten trees, rather than a single tree, became the unit of the study. The cones were taken from all parts of the crown of each tree and the proportion of those taken to the total yield of the tree was carefully noted. For each tree a detailed description was made by the collector, including such points as size, age, tree class (whether dominant or suppressed in the stand) character of crown, condition of health, etc., besides the important features of the site in which the tree grew. A sketch of the tree was also made to show the shape and proportions of the crown and the location of cones upon it. The trees were not marked for future examination, since, in the case of the older trees, the cones were gathered after the trees had been felled in the process of logging.

As the cones were received at the Experiment Station each lot was given a number, and all information concerning the seed or seedling resulting from that lot of cones has thenceforward been recorded under this number. By this means the chance of personal prejudice toward one conclusion or another in making observations is eliminated, for the observer knows nothing of the source of the stock he is examining. From the time of their arrival at the Experiment Station, the cones and seeds, and the seedlings raised from them, have had identical treatment. In a number of



THRESHING DOUGLAS FIR CONES

When facilities do not permit sending the entire cones in to the kiln house, the ranger threshes the cones where they are collected, thus leaving only the seed to be sent to the main station. Although not so advantageous in many ways, this method allows large quantities of seeds to be brought from the outposts which would not otherwise be available. (Fig. 2.)

cases larger quantities of cones than the usual sample were collected from particular trees for use in special supplementary studies. The various steps in the study have yielded voluminous data on the cones, seeds and seedlings, only the general nature of which can be indicated here.

THE CONE AND SEED

1. Study of the green, unopened cones, their condition and color; measurements to obtain the "number of cones per bushel" and "number of bushels per tree."

2. Drying of the cones; extraction and cleaning of the seed. Records were made of the amount of uncleaned and cleaned seed per sample, per tree and per bushel of cones.

3. Seed study. Counts, weights and measurements to determine size of seed; number of seed (with chaff, mill-cleaned and hand-cleaned) per pound and per bushel of cones; cutting tests to determine purity.

4. Germination. Tests made in the greenhouse during the winter of 1912 were unsatisfactory. A sample of 300 seeds from each lot was therefore sown in the nursery in the spring of 1913 for outdoor germination, and this proved perfectly reliable. Such a test has been made each spring since 1913, and will be repeated annually so long as there remains sufficient seed in any of the

original lots. Uniform storage conditions have been maintained from the beginning.

THE SEEDLING

For the purposes of this study it is the behavior of the seedling in the nursery, and more especially its behavior as a growing tree in its ultimate place in the planting site, which forms the basis of final judgment upon the desirability of that seedling. In order to secure material for the study of this behavior, the seedlings of 1913 and 1914 were observed for two years in the nursery and then out-planted on various sites to form permanent forest stands.

Series of 1913.—The seedlings resulting from the germination tests of 1913 were closely watched in the fall of that year to determine the time of winter bud formation or "hardening." In the spring of 1914 they were transplanted in the nursery and at that time a number of seedlings was taken at random from each lot for minute study and comparison. In the fall of 1914 the height growth was recorded by measuring every tenth plant in the beds, and the process of "hardening" was again observed.

In the spring of 1915 the plants, then two years old, were lifted for final planting in six different sites in four different geographical regions. Ten representative plants of each lot were again taken for intensive laboratory study. Twenty plants of each lot were sent to each of these sites, making a total final planting of 120 trees for each original seed tree from which cones were gathered. For twelve of the original trees, possessing features for which broader averages were desired, from 50 to 100 transplants were set out in each site. The plants were spaced 7 feet apart each way. Each plantation covers an area of nearly four acres and contains approximately 3,400 pedigreed plants, each of which is marked with an aluminum tag bearing the original parent tree number and the individual number of the seedling in its row. The total number of plants of the 1913 series, outplanted in 1915, is thus 20,400.

Series of 1914.—In order to strengthen the whole study, the entire procedure outlined above was repeated with the seedlings of the 1914 germination series, each operation following the similar operation in the 1913 series by just one year. In the final outplanting to the same sites in 1916, however, only ten plants for each parent tree were set out in each site, since it was believed that this number was sufficient to serve as a check upon the 1915 plants.

PLANTING SITES

The permanent planting areas, and the features for which they were selected are as follows:

1. Northern Cascades: On the Snoqualmie National Forest; 40 miles east of Everett, Washington, on the South Fork of the Stillaguamish River; altitude, 1,900 feet.

2. Middle Cascades: On the Columbia Forest; 7 miles north of the Columbia River; altitude, 1,200 feet.

3. Middle Cascades for altitudinal range: Three areas on the Oregon Forest; 5 miles southwest of Mt. Hood, on the headwaters of the Sandy River:

I. 2,800 feet elevation, north slope.
II. 3,700 feet elevation, north slope.
III. 4,600 feet elevation, north slope.

4. Coast Region: On the Siuslaw Forest, in the coast range (Mt. Hebo); 20 miles south of Tillamook; altitude, 2,000 feet.

RESULTS

The results of the study fall naturally into two divisions, the first including the statistical data concerning the cones, the seed, and the germination and behavior of seedlings in the nursery; the second embracing the development of the seedlings in the final field plantations.

The results of that portion of the study dealing with the cones, the seed, and the seedling in the nursery have been exhaustively presented in a progress report written in 1914 by C. P. Willis.[2] The great range of conditions

[2] For the substance of this official report the reader is referred to the article, "A Study of Douglas Fir Seed," by C. P. Willis and J. V. Hofmann, in the Proceedings of the Society of American Foresters, Vol. x (1915), pp. 141–164.

DUMPING DRIED CONES INTO ELEVATOR

After the cones are collected, they are brought to the kiln house where they are placed on trays and put in hoppers which carry them to the shaker, where the seeds are removed. (Fig. 3.)

represented by the parent trees made possible so large a number of comparisons and factor combinations that eighty-three tables were compiled to express graphically the numerous relationships. The interplay of the factors involved can be indicated by listing them in juxtaposition:

Age of the parent tree. Size of the parent tree. Health of the parent tree. Growing space of the parent tree. Altitude of the parent tree. Latitude of the parent tree Soil quality of the site.	Seed: (*a*) Yield of cones per tree. (*b*) Size of cones. (*c*) Yield of seed per tree. (*d*) Size of seed. (*e*) Quality of seed, germination per cent. Seedling in nursery: (*a*) Establishment. (*b*) Size of seedling. (*c*) Rate of growth. (*d*) Hardiness.

It will be appreciated that not all the first column factors will affect all the points in the second column, and also that such a feature as "size of seed" might influence both "establishment" and "size of seedling" in its own column. It is not possible, within the limits of the present article, to discuss the detailed conclusions, but some idea of their trend can be given by a consideration of their practical application. The tabular comparisons were variously decisive, but, on the whole, the results have served to formulate a number of recommendations for cone collection and for the selection of seed trees. These recommendations are not regarded as final, for it is almost certain that the future development of the plantations will change some of our present ideas. European experience has shown that such long-lived plants as forest trees require some years to reveal their hereditary traits. In Sweden, for example, the failure of many plantations from imported seed did not become evident until twelve or fifteen years after planting. The following recommendations are based upon two years' study of seedlings in the nursery. It seems inevitable, therefore, that the observation, through many years, of the same seedlings in various field plantations must result in some reversal of opinion and in the disclosure of facts at present unthought of.

1. Gather cones in a locality as cold as or colder than the planting site. The colder the habitat of the parent, the stronger is the tendency of the seedling toward early maturing of growth.

2. Collect from open-grown trees where practicable, since such trees produce larger crops of cones, larger yields of good seed per bushel of cones, and larger two-year-old seedlings than do forest-grown trees.

3. Seek large cones where practicable. Large cones have large seeds which offer better chance of seedling establishment and produce large first-year seedlings. (This advantage of size is usually lost in the second year.)

4. Collect from young or middle-aged, small or large trees, as convenience demands. Young trees produce large seed and vigorous seedlings; such trees are easy to climb and permit rapid work in collecting.

5. Avoid trees growing on poor soil. Such trees give low yield of good seed per bushel of cones. Seedlings also seem to inherit a stuntedness of growth.

6. Avoid extremely high altitudes in collecting unless the ultimate planting site is very high. High altitude trees generally give small yield of good seed per bushel of cones.

7. Avoid trees diseased by fungous growth, "conky" trees, for these give low yield of good seed, and the seedlings are inclined to be stunted. Until this point is cleared by further study, it is safest to assume that the tendency to disease, or rather the lack of resistance to disease, is hereditary.

8. Avoid insect-infested cones because of small amount of good seed. Insects work rapidly and the damage is worse if the cone crop is light for the locality,

GENERAL VIEW OF SEED KILN

Located at Wyeth, Oregon, the Wyeth Seed Kiln is typical of the type of plant where the Douglas fir seeds are prepared for germination. (Fig. 4.)

because the insect attack is then concentrated.

SELECTING TIMBER SALE SEED TREES

With the exception of the factors of soil quality and health of the tree, all considerations in this matter can be subordinated to commercial expediency. Since every tree left on a cutting reduces the lumber yield of the area to the extent of its own merchantable volume, it is essential to leave as few trees as are necessary to assure the reforestation of the area. The best seed tree, therefore, from the lumberman's standpoint, would be one which is worthless for lumber, hence a tree which is either defective or below merchantable size.

From the standpoint of the silviculturist, the best tree to leave would be the one which produces the greatest quantity of good seed per tree. The present study indicates that medium-aged (200–300 years), rather large trees (3 to 4 feet in diameter) produce five times as much good seed as very small young trees or very old large trees. Unfortunately, such trees are also the most valuable for lumber and consequently the most costly to leave.

Young or old trees can be left as seed trees, but the number left should be guided by the amount of seed produced as just stated.

Open-grown trees should be preferred. These yield more seed and better seedlings, and are also more windfirm than forest-grown trees.

Avoid, if practicable, leaving trees which grow on local patches of poor soil. These yield less seed and smaller seedlings than trees on good soil.

Avoid leaving diseased trees. These produce less good seed and smaller seedlings than sound trees, other things being equal. There is also a possibility that the progeny of such trees will be of low vigor in resisting disease.

Regarding the last rule little can be declared with certainty. Whether the tendency to disease is inherited; whether this tendency, if inherited, is offset by giving the offspring the advantage of a more favorable environment; and whether we actually lower the quality of the forest by leaving diseased seed trees—

SEED BED FRAMES MEAN SAFETY FOR SEEDLINGS

Frames are constructed with burlap sides and shaded tops which insure even germination. Covered with wire netting, rodents and birds are unable to gain entrance. Care and attention paid to seedlings assures a sturdy growth for transplanting. (Fig. 5.)

these questions constitute a problem of vital importance and absorbing interest. It is not possible to draw positive conclusions from three or four years of work. It is hoped that the future development, on the different planting sites, of the seedlings from diseased parent trees will throw some light upon this problem. It is planned, moreover, to amplify this phase of the study by the collection of seed in the fall of 1917 from a considerable number of diseased trees, and from an equal number of trees which are sound but otherwise as similar as possible to the diseased trees. The pathology of the diseased trees will be carefully studied and the whole conduct of the work will be more intensive than was the case for this particular phase of the present study.

RESULTS FROM FIELD PLANTATIONS

The compilations of the growth measurements for two years in the 1915 plantations and for one year in the 1916 plantations have served only to emphasize the impossibility of drawing conclusions from such short-time observations. There were no consistencies which can be cited as even indicating the possible trend of differences among the various classes of trees. It is too soon to expect the true hereditary qualities of the trees to appear in any measurable degree. At the end of the first five years, however, detailed compilations will be made which are expected to yield at least indicative results. At the end of twenty years the problem, for immediate practical purposes, should be solved.

It is a superior merit of Government research that the element of time need not hamper the plan or ultimate conduct of an important study. In the present instance it is planned to make observations of the field plantations for at least forty years, and in all likelihood it will be found that valuable data can be ac-

cumulated through one entire "management rotation." Such a rotation will probably mean, for Douglas fir, a period of 120 or 150 years. The imagination refuses to venture concerning the methods of study at so distant a time. The largeness of the idea is at once gratifying and disturbing, for one feels both the importance of the work and the responsibility of doing rightly the early steps in that work, lest the initial errors and omissions grow in magnitude with the advancing years.

ACKNOWLEDGMENTS

The plan for the seed collecting and seed testing of the Douglas Fir Seed Study was prepared in 1912 by Thornton T. Munger, then Forest Assistant at Portland, Oregon. The conduct of the seed collection and all of the first year's work was under the direction of C. P. Willis, of the Wind River Experiment Station. His careful work with the cones and seeds was productive of the detailed conclusions upon that phase of the study. He has also prepared a report on numerous incidental studies relative to methods of cone drying, seed extraction and time of cone gathering. Since 1913 J. V. Hofmann has been Director of the Experiment Station and has had general supervision of the work. He planned the field plantations and selected the sites for the altitudinal and regional tests for hardiness and growth of seedlings. The writer's connection with the study began with the collection of a portion of the cones, and has continued to the present time. The article by Mr. Willis and Dr. Hofmann in the *Proceedings* has been freely drawn upon in the present writing.

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3. Tall och Gran af Sydlig Härkomst i Sverige, by Edvard Wibeck in *Meddelanden fron Statens Skogsförsöksanstalt*, Stockholm, Haftet 9 (1912), pp. 75–134. (The influence of the origin of seed for artificial forestation. Reviewed by G. A. Pearson in *Proc. Soc. Am. Foresters*, Vol. ix (1914), pp. 113–119.)

4. The Effect of the Source of Seed upon the Growth of Douglas Fir, by Count von Berg, Sagnitz, Livonia, Russia. A report submitted to the U. S. Forest Service, from whom von Berg secured the seed for his study. (Abstracted by Raphael Zon in *The Forestry Quarterly*, Vol. xi (1913), pp. 499–502.)

5. Versuche über individuelle Auslese bei Waldbäumen I, *Pinus silvestris*, by Dr. E. Zederbauer, Austrian Experiment Station, in *Centralblatt für das gesammte Forstwesen*, May, 1912, pp. 201–202. (Studies of the Individual Heredity of Forest Trees. Reviewed in *Forestry Quarterly*, Vol. x (1912), p. 733. "Part II—*Pinus austriaca*" reviewed in *Forestry Quarterly*, Vol. xi (1913), p. 418.)

6. The Influence of Age and Condition of the Tree Upon Seed Production in Western Yellow Pine, by G. A. Pearson, U. S. Dept. of Agriculture, *Forest Service Circular* 196 (Jan., 1912.)

7. Annual Reports of the American Breeder's Association, Washington, D. C. These reports contain valuable reports and reviews by the Committee on Breeding Nut and Forest Trees, many of which are pertinent to the present work.

8. The work of a number of European investigators may be found as follows:

Prof. A. Cieslar: *Centralblatt für das Gesammte Forstwesen*, 1907, p. 1.

Dr. Dengler: *Zeitschrift für Forst und Jagdwesen*, 1908, p. 137.

Prof. G. Huffel: *Revue des Eaux et Forêts*, 1912.

Dr. M. Kienitz: *Zeitschrift für Forst und Jagdwesen*, 1911, p. 4.

Cooperative Move to Improve California Citrus Orchards

Six years of study have proved that more than 25% of the trees in California citrus orchards are unprofitable. They are undesirable bud variations that bear little or nothing. The California Fruit Growers' Exchange has now established a department of bud selection, the object of which will be to secure and furnish to all growers buds from tested trees, in order that they may propagate only desirable strains of oranges. This is a unique instance of widespread application of the teaching of modern plant-breeding.

RACIAL VALUES IN THE WAR

France and Great Britain Seem Least Able to Make Good Their Losses—Future Lies in Hands of Germans or of English-Speaking Peoples Outside of England—Need for Eugenics

REVIEW OF A BOOK BY SETH K. HUMPHREY

THAT the Great War will markedly affect the future history of the world is universally recognized, but the exact nature of the effect is not so often discussed. Seth K. Humphrey devotes much space to it, in an interesting series of essays[1] which serve as an introduction to eugenics. He concludes that England and France have passed their highest points, and that the future belongs to the Germans or the extra-Brittanic Anglo-Saxons, that is, America and the English colonies.

A relatively small loss of men will seriously cripple a nation, he points out, if these men are the best she has.

"Someone has said that if France were to lose fifty of her greatest statesmen, fifty leading scientists, fifty each of her shining lights in education, art, music, and so on, there would be nothing left of France. This states in an exaggerated way a deep truth which can be far more convincingly illustrated. We may continue with France as an example, although the case fits England, Germany, and America as well.

"The population of France is about forty millions. Then, instead of a few hundred suppose France were suddenly to lose four hundred thousand, 1%, of her very best in human values; not of the physically best, such as are being lost in the horrible war, but of the best in intellectual and creative ability, in leadership, in genetic worth. What would be left of France? Gather in every man and woman in France who leads, sustains, creates, and brings to pass the things that are vital to her life; then to the sum of all these add as many of equal potential worth, who in the nature of things would succeed them; and still this 1% conscription of France's best would be unfilled. Add, again, the most promising child in every family that has ever produced exceptional ability; it is doubtful whether then the list of four hundred thousand would be complete.

"This idea is so pertinent that it cannot be impressed too strongly. Take the illustration to England—eliminate a half million of her active and potential leaders; and to Germany—subtract six hundred and fifty thousand from her best genetic values. What would be left of Europe?

AMERICA'S LEADERS

"Bring it home to our own United States. One per cent of the population is one million. Ten times this many physically fit could be raised to defend their country, but could we find a quarter of one million who have a vital, constructive part in the making of it? If so, remove these from the nation's life, and then, to complete the lists, three times as many more chosen from the most promising of the country's blood. What would be left of the United States?

"A smaller unit may bring the idea closer. In New York City is supposed

[1] Mankind—Racial Values and the Racial Prospect, by Seth K. Humphrey. Pp. 223, price $1.50 net. New York, Charles Scribner's Sons, 1917. Mr. Humphrey, a Boston business man and author but a serious student of biology, outlines the problems of eugenics in the most elementary terms possible, dispensing not only with references to authorities but even, for the most part, with citations of facts. While the book is admirably planned and, on the whole, shows notably sound judgment, the addition of more statistical data would have added to its value. Although many of Mr. Humphrey's conclusions are naturally open to question, his point of view is so intelligent and so lucidly set forth that it is to be hoped he will follow up this essay with a more detailed and documented study.

to be concentrated much of the country's ability. A list of one hundred would include New York's really big men. The names of not more than one thousand would be generally recognized in the country at large for actual achievement. 'Who's Who in America,' with its fine-tooth comb, finds less than four thousand men and women worthy of its not too discriminating pages. New York is popularly considered as swarming with financial and industrial magnates. Within the limits of a thousand one could put all its leaders of finance and captains of industry, and still have places to spare.

"Yet the toll of 1% would call for *forty thousand* of New York's best. What would be left of New York?

"It seems incredible that the loss of only one individual in every hundred could so devastate human values in any vigorous nation. But we are wholly misled in our estimate of a nation's strength by the always satisfactory proportion of its physical vigor. Physically, a people can hold its own almost indefinitely. In the physical display which any active nation can make we lose sight of the rather appalling fact that its constructively effective brains are concentrated in the heads and inheritances of an unbelievably small number."

Of course it is frequently objected that the visible ability does not represent all the potential ability. There are many, it is supposed, who would rise if they had the chance; they are the mute, inglorious Miltons who through lack of education or through economic difficulties have never been able to reveal to the world what there is in them.

This objection rests on doubtful ground, genetically. Nevertheless, it may be allowed for. "Suppose we make this allowance generously and assume that, for every individual who develops exceptional capacity, there are ten sources from which his like might possibly rise; in other words, raise our estimate of sustaining inheritances from 1 to 10%. Then, for a single convincing example, make the toll from Greater New York 10%—four hundred thousand of her best in genetic values. Does the wildest optimist believe that New York's population would then hold anything more of racial promise than the decadent populations of the Mediterranean?

"It is a startling thought that inheritances of the quality essential to the effective maintenance of civilization are lodged exclusively with a scant 10% of the population. Yet that is the logical conclusion if we accept what appear to be plain facts."

THE POSITION OF FRANCE

Now in estimating the probable effect of the war on the various nations involved, it must be asked how much they can afford to lose? Are they eugenically sound and likely to be able to make good the racial damage which they will incur? Mr. Humphrey begins his study with France.

"Race mixture has not been much of a degenerating influence in France. Her race values have gone down under the long-continued failure of her best stocks adequately to perpetuate themselves. Compared with the other great nations of Europe, France has had longer periods free from tormenting wars—periods given over to the advancement of culture and to the enjoyment of it. Luxury has had more time and opportunity to play havoc with her race values, and in this, luxury has been assisted by the very quality of French temperament which has made the glory of French culture. No new blood can come to France—her resources are within the realm. Her African possessions are more of a drain than a prop to her racial vitality.[2] Her decline is not to be stayed by a forced rise in the birth rate; numbers secured in that way add nothing to race values. Her handful of effectives is shrinking—as those of her rivals are shrinking, only faster—and no agitation over birth rate can set the effectives of France, or any other nation for that matter, to mending their ways. France is nearer to the critical disproportion between her con-

[2] This is not true of North Africa. The birth rate in Algeria is relatively high and the population shows much of the vigor that is expected in a new country.—THE EDITOR.

structive and non-constructive elements than either of her greatest rivals—England and Germany. We can speak here of France and England as rivals, for a racial study may ignore alliances and look upon war as a dreadful episode, working disaster to the race values of all, but changing little the race relation by either victory or defeat."

"The outstanding fact for this inquiry is that France is not to be a source of future ability to make good the wastage of present civilization. We must look to peoples whose human values have not been so long and persistently exploited. France's contributions to the world's advancement may continue, but the days of her greatest achievement are in the past. Long before the world is over-hard pressed for sustaining race values, France will have ceased to be a dominant factor in its civilization.

GREAT BRITAIN

"Great Britain is pre-eminently the country of extremes in racial values. No other country excels her in the production of able men, in the adequacy of their numbers, and the genetic richness of the stocks from which they are derived. Yet Great Britain has a higher proportion of ineffective, underbred, hopelessly inferior white stocks than any other dominant nation.

"We are not interested here in the political significance of this condition, nor in the sectional exclusiveness, the persistent social isolation of types, which have carried differentiation of genetic values in Great Britain to unprecedented lengths. Let us take the condition as it exists.

"No great power has come to permanent disaster solely through the increase of its unsocial population. There must be also a drop in its effective values. One able man outnumbers a hundred ineffectives in the control of any situation not actually developed into a riot and the mob is the most effervescent of any manifestation of power. England is keenly alive to the threat of her racially depreciated masses—in London's East End, in Liverpool, Manchester, Glasgow, in the substratum of her agrarian population, and throughout all her manufacturing and mining regions; not the steady workers, but the hordes of intermittents and unworkables effective only at the business of reproducing their kind, adding misery to misery unceasingly. They make for England a social problem that is already a severe tax upon her resources of control, and will become more imposing when the war ends. Yet they will never get their hand upon Great Britain's helm until failure of her best stocks compels the last remnant of her dominant blood to let go. If England can devise a way to reduce the fecundity of her ineffectives she may lighten her social burden, but for the preservation of her national life she must look to the adequate perpetuation of the high genetic values which supply her with able men.

"Thus Great Britain's approach toward a critical disproportion between her sustaining and her socially dependent stocks is an arithmetical certainty. As with France, the time of her arrival cannot be computed in years, or decades, or centuries. This war has disclosed the remoteness, not the nearness, of her downfall. We simply know that the racial values of Great Britain are distinctly on the wane, and that unless something occurs to reverse her racial trend she will have been counted out in favor of less debilitated peoples long before the world loses the last of its Aryan civilizations.

"But the superb English inheritance has gone to all parts of the earth, to develop the traditional English resourcefulness long after the home stock shall have been depleted of its effective values. England's contribution to the world's genetic values is to be her crowning achievement. The great civilizations in North America, Australia, New Zealand, South Africa—in the generations to come, any one of these may grow to be another England in world strength. If under a new conception of human relations these English-speaking peoples yield their small differences and get together in singleness of purpose, the dominating world civilization for unnumbered centuries to come will be English in language and in those qualities which have made England great.

Upon this union depends the survival of individualism in its most wholesome aspect.

RUSSIA'S OUTLOOK

"Russia, because it is a land of immense numbers and unknown racial values, is popularly regarded as a mighty reservoir of human possibilities, awaiting only better environmental conditions for their expression.

"This is presuming on ignorance. Because Russian capacities seem to be mostly untried, it is not safe to assume either that they do or do not exist in quality fitted for a self-sustaining development. The Slavic masses of Russia, like every other people from Hottentot to finest Aryan, come to a higher level of existence under improved conditions, yet we have learned that very few, even among the ablest races, actually contribute to the maintenance of that higher level. Our inquiry is not for peoples capable of *receiving from* civilization; it is for the few capable of giving to it. This indicates the question which we now ask of Russia.

"To begin with, we must distinguish between the numerous and variegated Slavic peoples of Russia, and the half-Teuton handful that not only dominates but is the Russian Empire as we know it, so closely is it identified with everything constructive in Russian life. Russia may be said to be an Asiatic monster with a half-European head. It is in the monster, not in the head, that Russia's unknown racial values lie.

"Russia embraces a most heterogeneous population of one hundred and fifty million people, two-thirds Slavic, nearly one-third ranging from strong infusion of Mongolian to Aryan mixtures with inferior stocks of unknown origin. In the absence of any definite racial history, we are compelled to estimate Russia's inheritance values largely by inference from the degree of progress she had made in her contracts with other peoples of Europe.

"A strong argument against the possession of any high degree of initiative and creative capacity by the Slav is in the very fact of his continued submission to domination by groups essentially foreign in blood. No true Aryan stocks leave the expression of their national, commercial, and industrial life so generally to a foreign element. The natural inference from this condition is that the Slavic inheritance does not well compare with the Teutonic in the qualities adapted for taking a leading part in civilization.

"Another convincing evidence of the inferior quality of the Slavic inheritance is in the slight contribution the Slav has made to the world's attainments. From her manufacturing processes to her art, everything that is best in Russian life is borrowed. Even the example and inspiration of his European overlords have not led the Slav to a degree of self-expression that gives promise of any unusual future for his people.

"It is too early—a generation too early—to assume that the recent overthrow of the Czar and his government means a democracy for Russia. We might as well have hailed Mexico as a glorious democracy when Maximilian fell. Illiterate Russia has many years of painful struggle, of slow education, ahead of her before she can even determine the capacity of her suppressed millions for self-government. The revolution was directed against Germans and Pro-Germans; there is unquestionably a strong Teutonic infusion in the Slavic upper classes that is Pro-Slavic, and will act with the new regime. Russia may have a more liberal government, but for years to come it will be such as the Teutonic-Slavic ruling class chooses to give her. True democracy is a dream for a people three-quarters of whom are decades away from adequate self-expression.

"To whatever heights the Slav may attain, the indications are that those heights will be below the level of the pure Aryan. No persistent borrowers or imitators of the Aryan civilization are destined to supplant the Aryan so long as he maintains his racial integrity. Mere numbers will never command his homage."

THE VIGOR OF GERMANY

"Germany, from the viewpoint of racial values, is the most interesting of

all the Aryan groups in Europe. In development of her inheritance she is the youngest—and youth is always full of possibilities."

"Germany's advantage is in the newness of her vigor, the abundance of her developed ability, and the small proportion of her human dross. Germany has mistaken these for symptoms of racial superiority. While there is nothing in them to raise the world's civilization into realms unattained, they do assure to Germany a very significant length and strength of racial life for the attainment of those ideals of which the German inheritance is capable. They give to the German a survival value which other Aryan stocks in Europe do not possess. For this reason an estimate of Germany's exceptional prospects for survival should be of especial interest.

"Germany's survival values can be more safely measured against those of other peoples than in terms of years or centuries. In casting about for comparisons, it becomes evident that Europe has no stock that seems to promise the lasting quality of the German. But in America, Australia, New Zealand—in the stocks which for centuries have been going out from Great Britain to develop her possessions—there is the vigor and richness of genetic values that usually attend migration and selective development under natural conditions. These stocks bid for a future in every way comparable with the future of the German."

There is likely, then, to be a long struggle between the Germans and the English-speaking nations for world supremacy. "The decision, if it must come, will eventually rest upon survival of racial values. What, then, are the comparative racial prospects of Germany and the various English-speaking peoples?

"One outstanding difference is that Germany, self-sustained, fully populated will continue to hold an advantage she has held from the beginning, in being able to maintain the integrity and purity of her stocks against deteriorating mixtures. Without exception, the younger English-speaking peoples—and even England herself—have sought in varying degree the temporary advantage that comes from importing inferior stocks to do their less pleasant tasks.

HANDICAPS OF AMERICA

"Let us consider first our own racial prospect. In the three preceding chapters we have studied the results in the United States of this commercially profitable but racially suicidal mingling of unlike peoples. The African infusion, and the past, present, and future importations from non-progressive foreign stocks, together constitute what might be called an extraneous load upon our racial values. It is significant that a similar load of anything like its proportions does not rest upon any other English-speaking peoples, except, perhaps, South Africa. This seems to be a special handicap put upon the United States of America. Although disproportionate increase of superior and inferior stocks remains the chief factor in racial depreciation among all civilized peoples, our own special handicap is not to be passed over lightly. The tendency of twenty or more distinct peoples to maintain a relative separateness of ideals, while living as neighbors and outwardly subscribing to American citizenship, is only a few degrees less threatening than would be a free intermixture of all their inheritances. A long and persistent intermixture would tend to develop social unity in the much-heralded "true American" of the Melting-Pot, but may heaven preserve us from a unity that comes with the passive worthlessness of a downwardbred mongrel type. We can better afford racial separateness, with all its menace to social peace.

"Yet these rigid alternatives hold us to a most perplexing condition of suspended effectiveness; a workable social understanding cannot be forced against the persistent separateness of so many peoples, while a decent regard for the future of the race should turn us from the dull harmony of mongrelism. There seems to be no way out; but that very fact should restrain us from getting any farther in. In the light of present knowledge, further loading up with inferior stocks would be deliberate suicide.

"Whatever we may do to check further disastrous type mixtures, our disadvantageous start in this matter is bound to affect our future position with respect to both Germany and the English-speaking peoples. Yet against these racially and socially disquieting influences, the United States still has Aryan[3] values as effective as those of any inheritor of England's widely distributed legacy. Those early stocks were of the sort of genetic material to build a great republic. What if they did not foresee our careless invitation to peoples who could never respond harmoniously to their lofty ideal of culture? They thought that this was to be a land for their children's children, and they did their best to carry out the idea by following the Biblical injunction to the people of the earth. They were prolific; their increase overflowed westward again and again, as far as the Pacific coast, and their descendants in turn, effectively mingled with the sturdy product of the earlier migrations from northern Europe, have endowed this country with a fund of genetic values that needs only to be maintained—even in its present proportion— to insure permanence to the most fortunately situated people on earth. But to hold these values to their present proportion is the most difficult order ever put up to the American people.

CANADA'S ADVANTAGES

"Of the other English-speaking countries, Canada is a land of material opportunities comparable in many respects with our own. Racially she has the advantage of us in the purity of her British-descended stocks, and in the prospect of continuing that purity if she has the wisdom to choose to do so. The cloud on her racial horizon is her legacy of original French stocks, which persist in remaining at a genetic and cultural level below that of the dominant English-speaking population. They may fill a worthy place in Canada's economic scheme, but they do not furnish their proportion to the essential ability of Canada's people, and to that extent are a hindrance to her racial future.

"But in Canada, as with us, the Star of Empire has moved westward; and in that great West is the purest and best of her Aryan inheritances, needing, as ours, only to be perpetuated to make of Canada one of the great peoples of the world.

"The racial difficulties of South Africa do not augur well for her place among the English-speaking communities of the future. Her dominant people have displayed an admirable comprehension of race values in attempting to stay the almost overwhelming flood of inferior stocks, but the odds against them are so immense that nothing short of revolutionary tactics will save South Africa for a great Aryan future.

"The pure white of India is an exotic, and can never be anything else. Neither India nor any tropical country has an Aryan future. The beautifully mystical culture of India is essentially non-Aryan, and is not under discussion.

"In Australia and New Zealand we come again to lands brilliant in promise of a great future for the English-speaking Aryan. Both have their race problems, and both are meeting them with conspicuous intelligence. Countries of dimensions so magnificent, with resources scarcely touched and peopled by British stocks still in the full vigor of youth, have only to conserve the one and adequately perpetuate the other to make sure of a future well out into the unknown that lies ahead of us all.

"The United States, Canada, Australia, New Zealand—four young giants of the earth, growing and with abundant resources for further growth. Were these four, with England as their mutual bond, joined in singleness of purpose to carry forward to still greater achievement the humane culture that distinguishes the English-speaking Aryan, who could effectually set up against them? Germany has youth, but it is the youth that compares well with the old age about her, not with these four

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[3] It is unfortunate that Mr. Humphreys could not bring himself to give up the idea of an Aryan race, which has long been abandoned by ethnologists. When he says Aryan he usually means Nordic.—THE EDITOR.

lusty sons of Great Britain. Germany may more easily preserve the purity and strength of her inheritance within her realm, but her realm is full and her overflow must go out to an inevitable mingling with other peoples, unless by sheer force she gains foothold on forbidden ground. Any one of these four English peoples has undeveloped resources greater than the resources of all Germany. But resources alone determine nothing in human affairs; they are the instruments of resourceful peoples. What is more clear, then, than that English-speaking peoples, with their superior opportunities, have only to perpetuate their genetic values in order to make sure of a predominating influence in the future civilizations?"

NEED OF RACIAL ALLIANCE

"So we look out upon a future clouded with perplexities which can scarcely be defined. Against that uncertain future we must prepare. An unshakable bond of mutual understanding between the speakers of English is the most obvious preparation. But that alone will not suffice. We know that in the affairs of men mere numbers are of little avail, and the accumulated trappings of civilization have in themselves no lasting strength. The source of all strength is in an abounding racial vigor. It is the one sure reliance for the meeting of whatever may come. It is the motive power behind all successful human effort, and the failing of it is the palsy that marks nations for destruction.

"The truth of these things is making uneasy those whom superiority has heretofore made confident. They are beginning to see that without racial strength the mere numbers of the world's inferior hordes might indeed prevail against them.

"The threat of racial failure has given life to a new enterprise for the conservation of human values—Eugenics, 'Well-born.' So far it is the beginning of a promise. But in its main idea are possibilities now unthought of, awaiting only man's necessity and determination, to serve the race."

The Journal of Heredity During the War

Paul Popenoe, the editor of the Journal, whose active and painstaking efforts during the past three years have built it up, has been drafted into the military service of the country, and he has been granted leave of absence for the duration of the war. Herbert Popence has been appointed assistant editor, and it is believed that the Journal can be regularly issued, notwithstanding the absence of the editor, providing the members of the Society take their full war share of the responsibility for the Journal and furnish manuscripts which are adequately illustrated and of a wide general interest.

The Society is holding its own and making a steady growth, and the increase in interest in matters pertaining to the new science of genetics as a secondary result of the war will, I believe, experience a phenomenal growth as the war continues and, after the war, lead to many important changes which we as little comprehend now as we realized nine years ago that the flying machine of the boys of Dayton would be the greatest factor in this terrible struggle.

To lessen now the research work or the interest of the public in the science of genetics will in my opinion prove as shortsighted as the too practical policy we have pursued to our sorrow in the education and treatment of our analytical chemists.

As the head of the Aviation Construction Board remarked to me a few days ago, this war has become a war of the scientific men—the professors—the real technical experts and specialists.

The JOURNAL OF HEREDITY aims to interest the young men and women of the country in the great subject of genetics and encourage those who have research abilities to enter this constructive biological field for invention and discovery. It is more needed now than ever, and every effort will be made to enlarge and extend its influence.

DAVID FAIRCHILD,
President.

THE ANNUAL CATALOGUE OF PLANT IMMIGRANTS

Many Additions to Our Food Plants are Being Made by Office of Seed and Plant Introduction—To be Available Gratis to all Serious Experimenters Who File Application

DAVID FAIRCHILD

Agricultural Explorer in Charge of Foreign Seed and Plant Introduction, Bureau of Plant Industry, U. S. Department of Agriculture

THE war is demonstrating in a striking way the danger of being too practical. The technical knowledge required today to fight this war is touching everywhere the borderland of knowledge as never before, and there is hardly a specialist, no matter how narrow the field is in which he works, but has been called upon to furnish information of some sort.

Mankind has become willing as never before to listen to every suggestion and follow up every clue which may lead to important discoveries bearing on the war.

Changes in agriculture will necessarily come with the changes in transportation and the perfection of the farm tractor.

In order to get ready for these changes much experimentation will be required and thousands of men on their own places are needed to do this work. To expect this work to be done by state experiment stations and the Government agencies, and wait for these men to do it, would be like waiting upon the Government to discover the aerial highway. Individual initiative flew the first aeroplane and individual hybridizers will originate many new plant varieties.

The Government, through its Office of Foreign Seed and Plant Introduction, brings in every year several thousand species and varieties of plants, gathered from different parts of the world. These are for a wide trial in those parts of the country where they are likely to thrive.

The seventh Annual List of these plant immigrants is appearing in a few days and will be sent to *bona fide* experimenters all over the country. A few photographs, illustrating some of the economic and ornamental plants described in this 1917 Annual List are reproduced here in the Journal. There are 1400 interesting new plant introductions contained in this Annual List and applicants for it will be supplied up to the limit of the edition.

All plants listed are sent out gratis, on request, after adequate information has been received proving the capabilities of the applicant to take care of and experiment with these rare species and varieties.

It should be kept in mind that all plants described are newcomers to this country, and are, for this reason, experimental. No one should imagine that immediate profits are to be made out of them, and those whose interest is chiefly in the money end of the problem—who are first of all practical and after that plant lovers or investigators—will be too impatient for results to make good experimenters and cooperators of the Office of Seed and Plant Introduction.

Everyone who really loves, and knows how to grow and care for new plants, should get in touch with the Office referred to, and if the supply holds out get a limited number of the new introductions which in the opinion of the office experts have a good chance of succeeding.

ORCHARD OF HARDY OLIVES IN THE CRIMEA

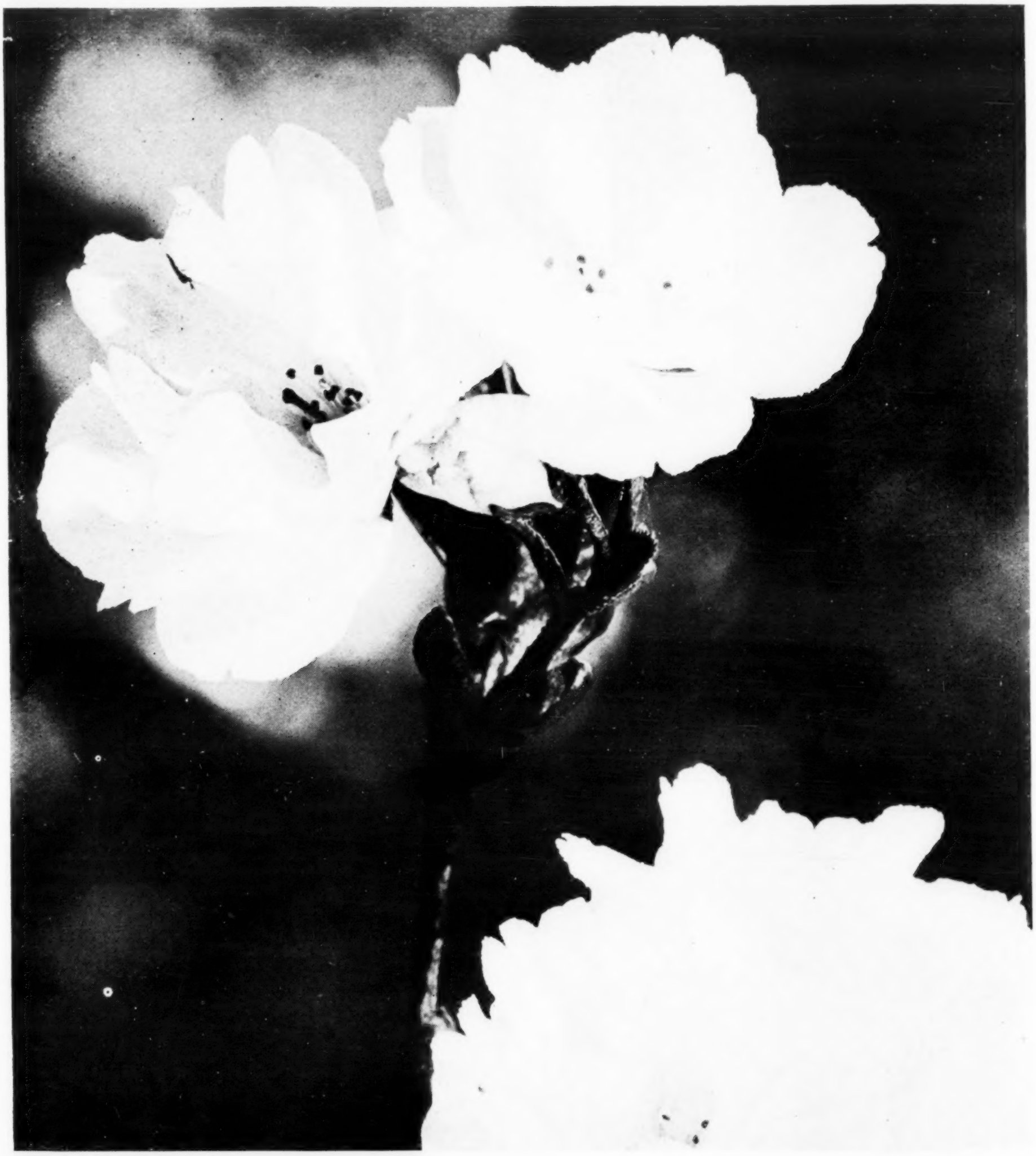
An Olive Orchard at Nikita, in the Crimea, which has stood practically uninjured temperatures of —2° F. at intervals for 60 or 70 years. (S. P. I. No. 27172.) Seedlings from this orchard should show unusual hardiness and may succeed in sections where other olive varieties have failed. (Fig. 6.)

As explained in the Annual List, all plants sent out are accompanied with special descriptive permanent labels, which are a great help to experimenters in keeping fresh in their minds the particular uses for which the plants were introduced.

Correspondence should be addressed to the Office of Foreign Seed and Plant Introduction, Bureau of Plant Industry, United States Department of Agriculture, Washington, D. C.

The following information is necessary and must be supplied on special Experimenters' Cards which will be sent to applicants on their request, before requests for plant material can be filled:

Permanent address: All plants are sent out by parcel post, not by express. Do you wish plant material sent to above address? If not, fill out permanent mail address for plant material. How much land have you available for experimental planting and how much do you wish to devote to such planting? Is this land owned or leased by you? Have you a water supply for irrigation purposes? Have you a green house? Are you interested in experimenting with: Grains; forage plants; fruit trees; small fruits; vegetables; shade trees; ornamental trees or shrubs; perennial flowering plants; annual flowering plants; house plants? If so, state below which you are especially interested in. Give your experience in caring for and experimenting with plants.

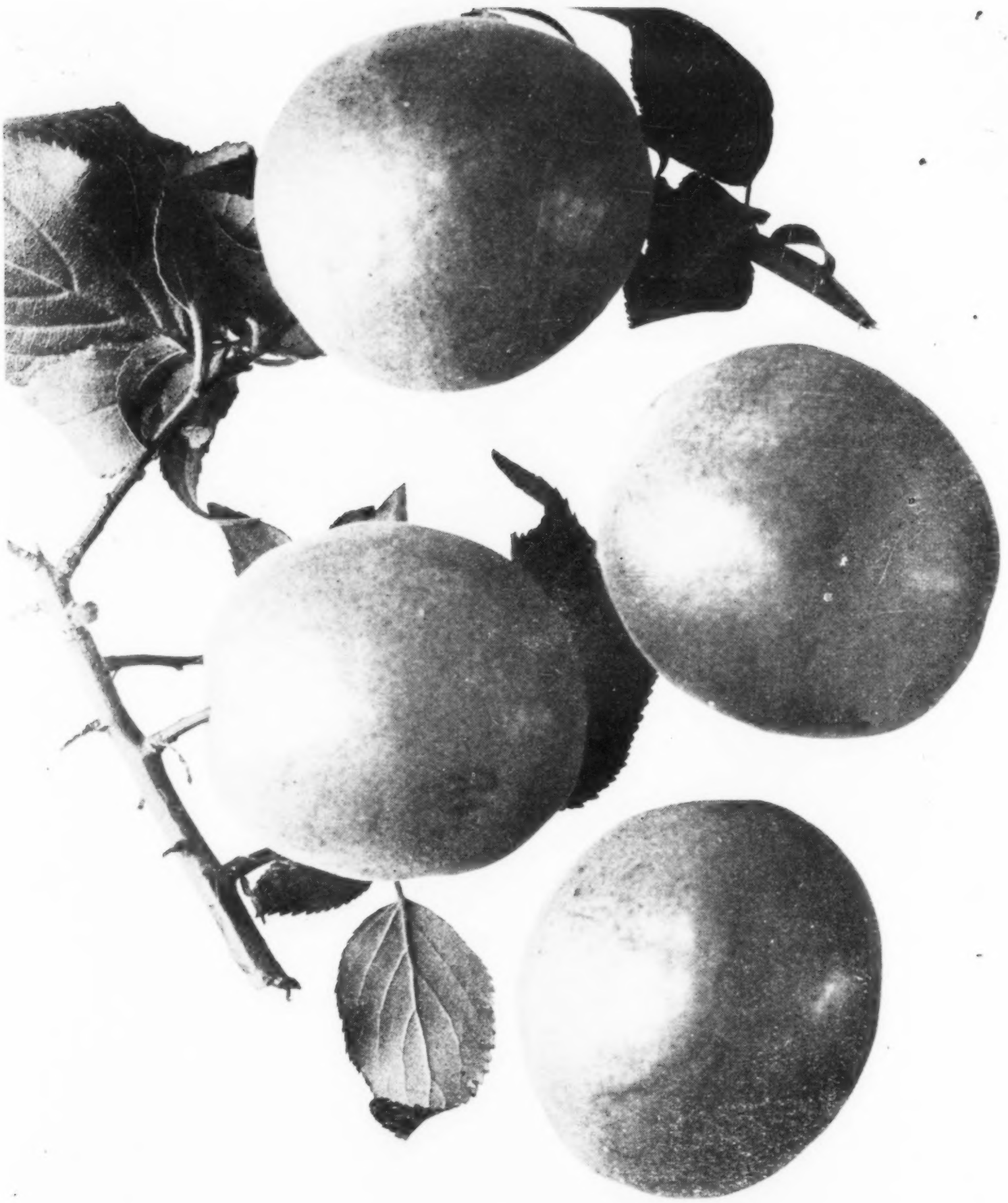


THE MURASAKI VARIETY OF JAPANESE FLOWERING CHERRY

The double-flowered cherry trees of Japan are preeminently trees for dooryards and small parks, and should be planted near garden walks, so that people can walk under them and enjoy close at hand the loveliness of their exquisitely delicate coloring. They are no more showy than our crab-apples when seen at a distance. The Murasaki (*Prunus serrulata*) S. P. I. No. 45056, is a deep-pink mid-season, very free-flowering variety (April 20 in Maryland). The blossom centers turn red with age, and the petals fall in great abundance turning the ground pink beneath the trees. In autumn the foliage turns a golden yellow. Photographed by Fairchild, twice natural size. (Fig. 7.)

THE OJOCHIN VARIETY OF JAPANESE FLOWERING CHERRY

Although this variety of *Prunus serrulata*, S. P. I. No. 45051, is not so profuse a bloomer as many of the strictly double-flowered varieties, its large, almost white blossoms, which are often quite single, remind one in their beauty of single roses, and when scattered over the branches, of a large-sized tree, as they usually are, they produce when viewed from below, a most impressive sight. It is a late flowering variety, May 1 in Maryland. Photographed by Fairchild, twice natural size in order to emphasize the beauty of the flowers. (Fig. 8.)

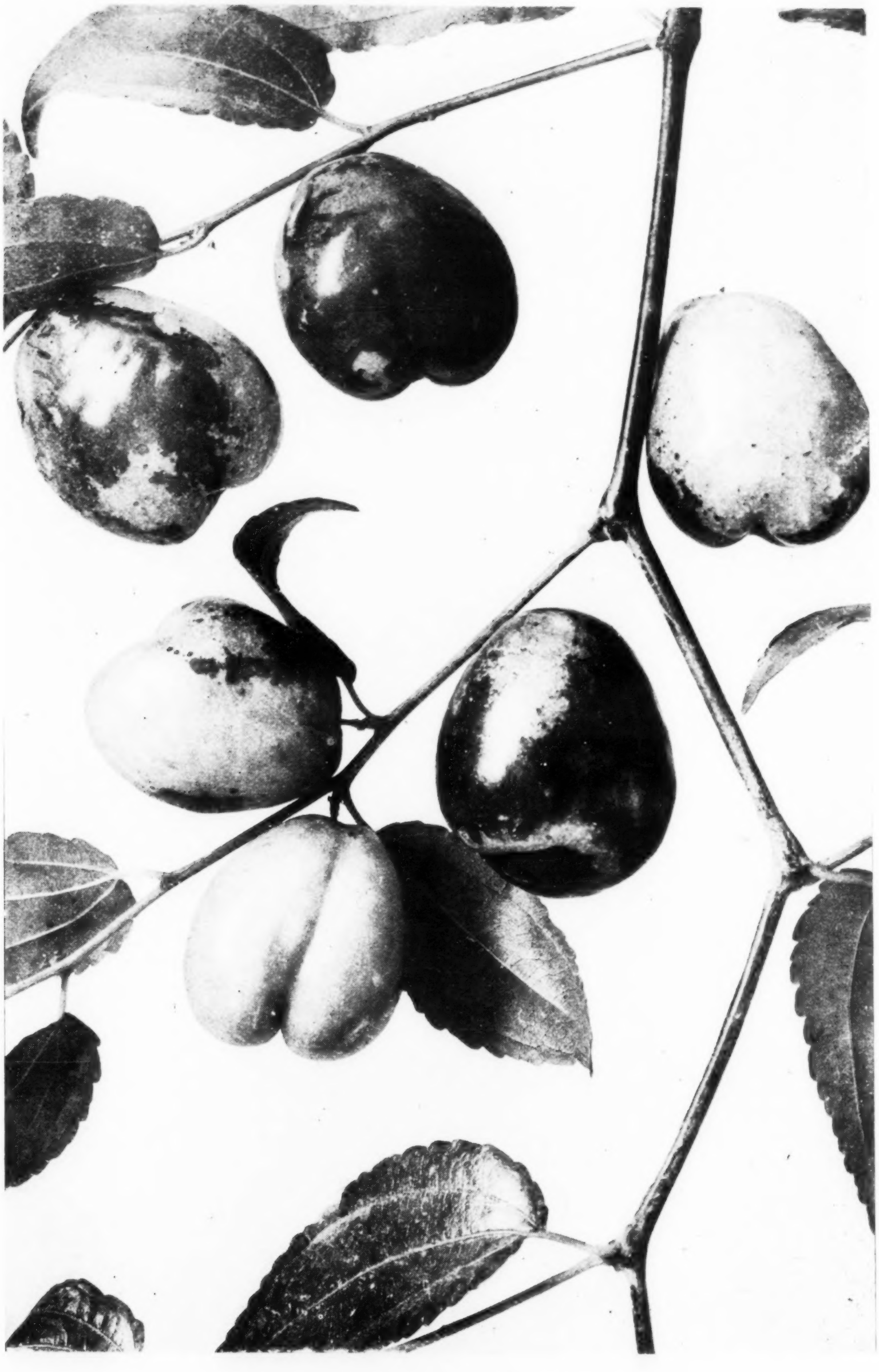


THE JAPANESE MUME OR UME

As a spring-flowering tree, the Japanese apricot (*Prunus mume*) or Japanese plum, as the mume is incorrectly called, is perhaps the favorite of the Japanese poets even more than the flowering cherry. It often blooms so early that the snows fall on the fragrant blossoms. The fruits remind one of the American wild goose plum in flavor but are much better keepers. They are preserved and made into jelly and put down in salt while still green. These salted or pickled mumes are among the sourest pickles known and are excellent with meats. They form a part of the Japanese soldiers' ration, and are said to quench thirst on long marches. Many varieties of these mumes are recognized in Japan. The illustration is of fruits produced at Chico, Cal. Five-year-old trees have borne in Maryland also. Photographed natural size. (Fig. 9.)

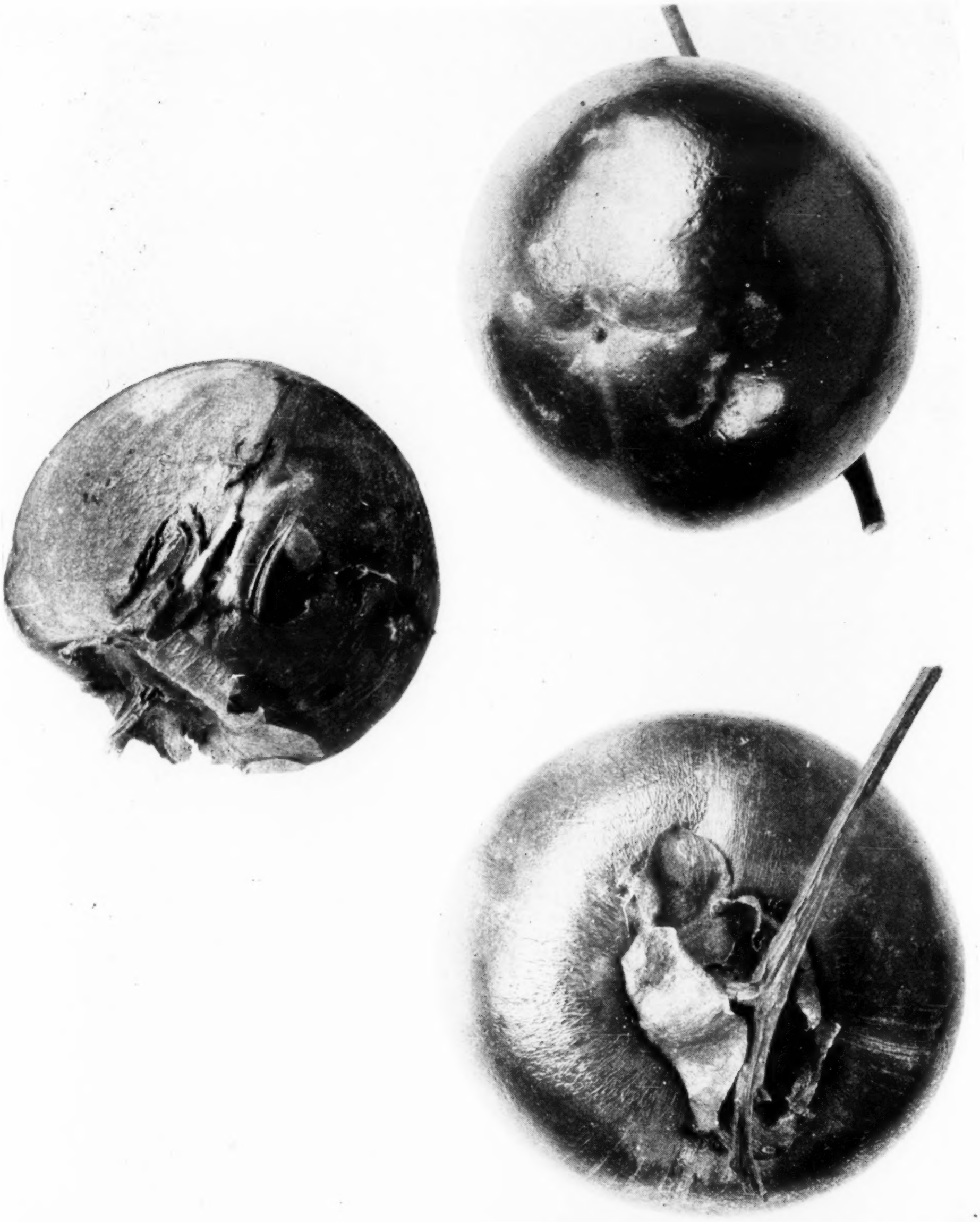
THE MU HSIN HUNG JUJUBE

An attractive medium-sized variety, S. P. I. No. 22684, collected by Frank N. Meyer at Tsintse, Shansi, China. Of good flavor and texture. The tree does not appear to be as heavy a bearer as smaller fruited varieties but it grows in China to a very large size with few side branches on the main limbs and has no spines. When processed the Jujube compares favorably with the date. Photographed natural size. (Fig. 10.)



THE CHINGCHOWFU JUJUBE

This variety, S. P. I. No. 30488, was introduced by the Rev. W. M. Hayes of Chingchowfu, China, and is said to be the largest variety of that region. The trees at Chico, Cal., have borne well and the quality of the fruits is excellent. Before ripening they are covered with brown blotches, which spread rapidly until the whole fruit is brown. As Mr. Hayes did not give the Chinese name for this variety the place name has been chosen. Photographed natural size. (Fig. 11).



A REMARKABLE PUCKERLESS PERSIMMON OF THE GOSHO CLASS

The greatest drawback to the persimmon has always been its astringency, which has made it necessary to ripen it until too soft to be eaten out of hand. This new variety which has first been fruited out in this country by H. Harold Hume of Glen St. Mary's, Fla., can be eaten while still as hard as an apple, and is then as delicious in flavor, and fine in texture, as the best of the soft varieties. It has a richer flavor than the Tamopan and appears to be more reliably tannin free, at least in Florida. S. P. I. 26773. Photographed three-fourths natural size. (Fig. 12.)

A NEW TYPE OF FRUITING CHERRY FROM CHINA

The Tanghsi cherry (*Prunus pseudocerasus*) S. P. I. 18587, orchards of which were shown to Mr. F. N. Meyer by the Rev. A. Kennedy, near the village of Tanghsi; in Chekiang province, has been identified as the true *Prunus pseudocerasus* of Lindley, under which name the Japanese flowering cherries have been commonly but erroneously known for seventy years. It appears that horticulturally, owing perhaps to the confusion in names, no attention has ever been given in America to this remarkable Chinese species of cherry. It turns out to be ten days earlier in fruiting than any other in northern California, and of sufficiently good quality without further improvement to attract commercial attention. The illustration shows a three-year-old bud on Mahaleb stock. (Fig. 13.)

AN INTERESTING STRAWBERRY PEDIGREE

THERE probably is no plant breeder who has not been much disappointed over the results of some particular cross which, from the history of the parents involved, had given every promise of fruitful returns; on the other hand it sometimes happens that parental varieties whose pedigrees seem to contain nothing of particular promise yield results of surprising value. A rather remarkable example of this appeared this year at the Experiment Station at Geneva, N. Y.

During the winter of 1889-90 C. E. Hunn, then acting horticulturist, pollinated the Johnson Late Strawberry with Sharpless. The female parent was a seedling of unknown origin sent to the station for test by a man named Johnson. Beyond being very late it did not prove of special promise and was soon discarded. Several seedlings were secured from this cross and these formed part of a lot of more than four hundred which fruited in 1893. The only one which eventually seemed worthy of retaining was one of these Johnson Late seedlings. This was named Hunn in honor of its originator. In 1898 Hunn was pollinated by Atlantic, a chance seedling from New Jersey of no remarkable value. The seedlings from this cross were grown in competition with about five hundred others and only one survived. This was named Quality. When Quality was grown in other localities it proved disappointing, and so was discarded, but not until seedlings of it were secured by self-pollination in 1907. None of these seedlings was found worthy of extended trial, but two of them, one perfect (with both stamens and pistils) and one imperfect (with pistils only), were retained in a study of sex. In this work the perfect was self-pollinated and the imperfect fertilized by the perfect. The resulting seedlings fruited for the first time this summer.

The seedlings of the selfed perfect were lacking in vigor, shy in yield, with small berries. The other seedlings obtained from the sister plant pollinated by this same perfect were one of the most remarkable collections that the station has obtained from a single strawberry cross. The plants were large and very vigorous and extremely productive with fruit above medium to large in size. Out of ninety seedlings in the cross twenty-four have been retained for further test—a proportion that has not been equalled by crosses involving some of the finest varieties under cultivation.

This is one of those cases which are the despair of the plant breeder because they seem to follow no law; but at the same time, if the breeder has something of the gambler's spirit and is willing to toss dice with nature, it is just such cases which encourage him to undertake work that otherwise would seem to have no justification save curiosity.

R. D. ANTHONY,
Agricultural Experiment Station,
Geneva, N. Y.

R. Ruggles Gates in British Military Service

R. Ruggles Gates, author of "The Mutation Factor in Evolution," who left the University of California last spring to enter the British Military Service, is now in the Royal Flying Corps. He is acting as instructor in machine gunnery at one of the aviation schools in England. His mail address is Care of University of London Club, 21 Gower Street, W. C., London.

MARRIAGE RATE OF NURSES

Less Than Half of the Graduates of the Best Training Schools Marry—Age Probably One Important Factor in This

THERE are in the United States nearly 200,000 women equipped to a greater or less extent to do nursing. About 79,000 of them are sufficiently trained to be registered. Physically the trained nurses represent a selection far above the average of the population, since only the physically superior can stand the strain; and mentally, too, they are probably well above the average. They represent, therefore, a desirable class eugenically, and it is important to know to what extent they marry.

Alumnae records of four of the larger training schools were examined from this point of view. The last class considered was 1901, since many of those who graduated since that date have still a possibility of marriage, while graduates prior to that time, being now more than 40 years old, are unlikely to marry, or if they did, bear children.

At the Massachusetts General Hospital, 560 graduates were listed. Eliminating fifty-six who died single, it was found that of the living, 213 or 42% are married.[1]

At the Johns Hopkins School for Nurses, 228 graduates were tabulated, of whom eleven had died single. Marriage was shown for 93, or 43%, of the living.[2]

At the Bellevue Training School for Nurses there was a record of 650 graduates,[3] 105 of whom had died single. The 185 who are married make a marriage-rate of 34%.

At the Training School of St. Luke's Hospital 201 had graduated and sixteen died single. Ninety-seven, or 52%, were reported as married.[4]

The variation from 34% to 52% in these complete married rates is considerable, and doubtless due to a very large number of causes. It was not possible to secure detailed class lists from other institutions, but five of the more important training schools courteously furnished such information as they had. Their data refer to all the graduates to date, and it is obvious that such figures are misleading, because the graduates of at least the last 10 years may still marry.

The Presbyterian Hospital in New York City states that its school of nursing has graduated 565 girls, of whom 163 have married. This makes a marriage rate (extremely incomplete, as noted above) of 29%.

At the Illinois Training School for Nurses (Chicago) 1314 graduates show 423 marriages, or 30%.

Of the sixty-two graduates of the Training School at Washington University (St. Louis) since 1908. thirteen or 21% have married.

The Presbyterian Hospital of Chicago has graduated 283 girls since 1906, of whom eighty-seven or 31% are married.

The University Hospital at Minneapolis is a young school; of its forty graduates only two have married.

In these five schools, it was not stated whether the total number of graduates given included those who are now dead; but presumably it did. Owing to the varying lengths of time involved, the rates given are not even comparable with each other.

BELLEVUE RATE LOW

It is interesting to compute the marriage rate of the graduates of Bellevue

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[1] Massachusetts General Hospital (Boston) Training School for Nurses, Report for 1916. Classes of 1875–1901 inclusive.

[2] The Johns Hopkins Hospital (Baltimore) School for Nurses, circular of information, 1916–1917. Classes of 1891–1901.

[3] Forty-third annual report of the Bellevue Training School for Nurses, New York City, 1916. Classes of 1875–1901.

[4] St. Luke's Hospital (Chicago) Training School for Nurses, announcement, 1917. Classes of 1887–1901.

Training School on the same incomplete basis, since the complete rate has already been presented above (34%). The total number of graduates up to and including 1916 is 1,102. The annual report gives the following summary of their records:

Private nursing	283
Married	268
Institutional work	119
At home	148
Social work	58
Practising medicine	14
Deceased	139
Army	3
Unknown	30
Still in school	40
	1,102

Dividing the total, 1,102, into the number of married, 268, gives a marriage rate of 25%. Since the five schools whose rates were computed on this incomplete basis are little higher than 25% it is by no means certain that their complete rates will be much higher than the complete Bellevue rate (34%).

No amount of optimism can bring one to conclude that the marriage rate of trained nurses—or at least of the graduates of the best training schools—is even reasonably high.

WELL FITTED FOR MARRIAGE

On the whole, the education of a nurse fits her admirably for home-making and mothercraft. It might be supposed that such women would be in great demand as wives. The fact that they marry to such a small extent may indicate:

(*a*) That men do not use good judgment in selecting wives (this criticism has been heard more than once from graduates of women's colleges,) or that there is something in a nurse's education which men object to.

(*b*) That the nurses prefer to remain single. Many of them doubtless are set on a career, but evidently not all, for of the living, unmarried graduates of Bellevue, who have left school but whose whereabouts are known, 16% are not following their profession, but have apparently given it up and are living at home. It is doubtless true that nurses, having careers offering abundant employment and good pay, can be and are much more exacting in their requirements of a suitor, than are girls who have no future in sight except matrimony. Their celibacy can not be very largely due to lack of opportunities to meet men, for their opportunities in this respect are notably good. It may be that their work sometimes results in pessimism or cynicism with regard to men and marriage.

CAUSES NOT EASILY DEFINED

Any attempt to analyze the causes of this low marriage rate must be futile, until some data are available; for the factors involved are doubtless mostly complex psychological influences. But there is one simpler cause that may be suspected—age. Ten or 15 years ago, the age of admission to good training schools was from 21 to 25 years. The average age of girls at graduation was certainly not less than 25. The nurses who graduated from the four large schools cited at the beginning of this study, in classes prior to 1902, were therefore well toward the end of the most marriageable period in a woman's life, at the time of their graduation. Lately the age standards of training schools have been steadily reduced, twenty perhaps being an average minimum, although many schools will now admit pupils at the age of 19. The average age of graduates is therefore now about 23, according to those who are in a position to form an intelligent opinion. This decrease of age alone should tend to increase the marriage rate of the more recent graduates, as compared with those a decade or two ago.

The standards of selection of nurses are believed likewise to be changing, more girls taking up the profession in place of teaching school and similar occupations. This should mean a further increase in the marriage rate.

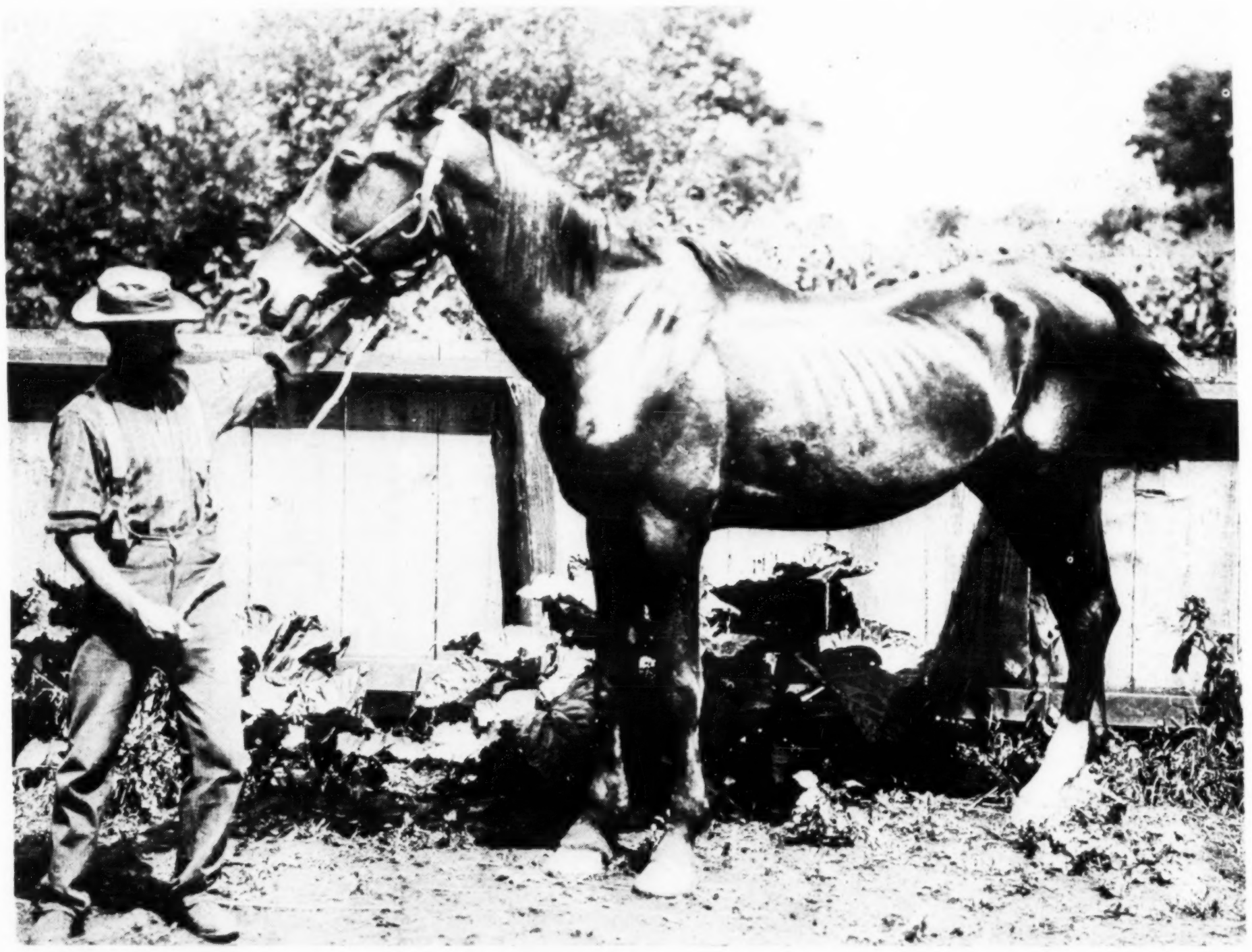
That such an increase is needed, in the interests of eugenics, will be generally recognized. It would be of much interest to know the birth rate among married nurses. Possibly some member of the American Genetic Association is in a position to investigate this.

BETTER HORSES

Industry Can be Rapidly Built Up in the United States by Elimination of the Inferior Stallion—Need of Horses in the War—Allies Have Taken Many, but Not the Best

IN SPITE of the fact that most of the cavalry troops in the world's armies have been dismounted and their dashing squadrons replaced by "tanks"; in spite of the fact that autos, tractors, and many other mechanical contrivances have been devised to replace the horse; nevertheless, the breeding of sound horses is of more importance to this nation today than ever before. The spavined, stringhalt, and ringboned horse is more than ever an undesirable member of the industrial forces, but the horse of good conformation and quality will steadily be in such demand that every sound animal will have a definite part to play both in war and in peace.

It is at such a time that the horse



A GRADE "TROTTING" STALLION

This animal was used from time to time for service in Wisconsin under the law prevailing there which permits the licensing of grade stallions for public service. So unsound and enfeebled that it would appear he would have difficulty in walking, it is hard to understand why he should be placed among the trotters. Popular choice, however, has demanded stallions of this breed and it is probably because of this popularity that the above veteran, who was palmed off on a new owner frequently, was included in this category, although to the experienced eye he presents many points in which he does not "favor" his supposed ancestry. Photograph from A. S. Alexander. (Fig. 14.)

HIS CHEAP FEE ATTRACTED MANY

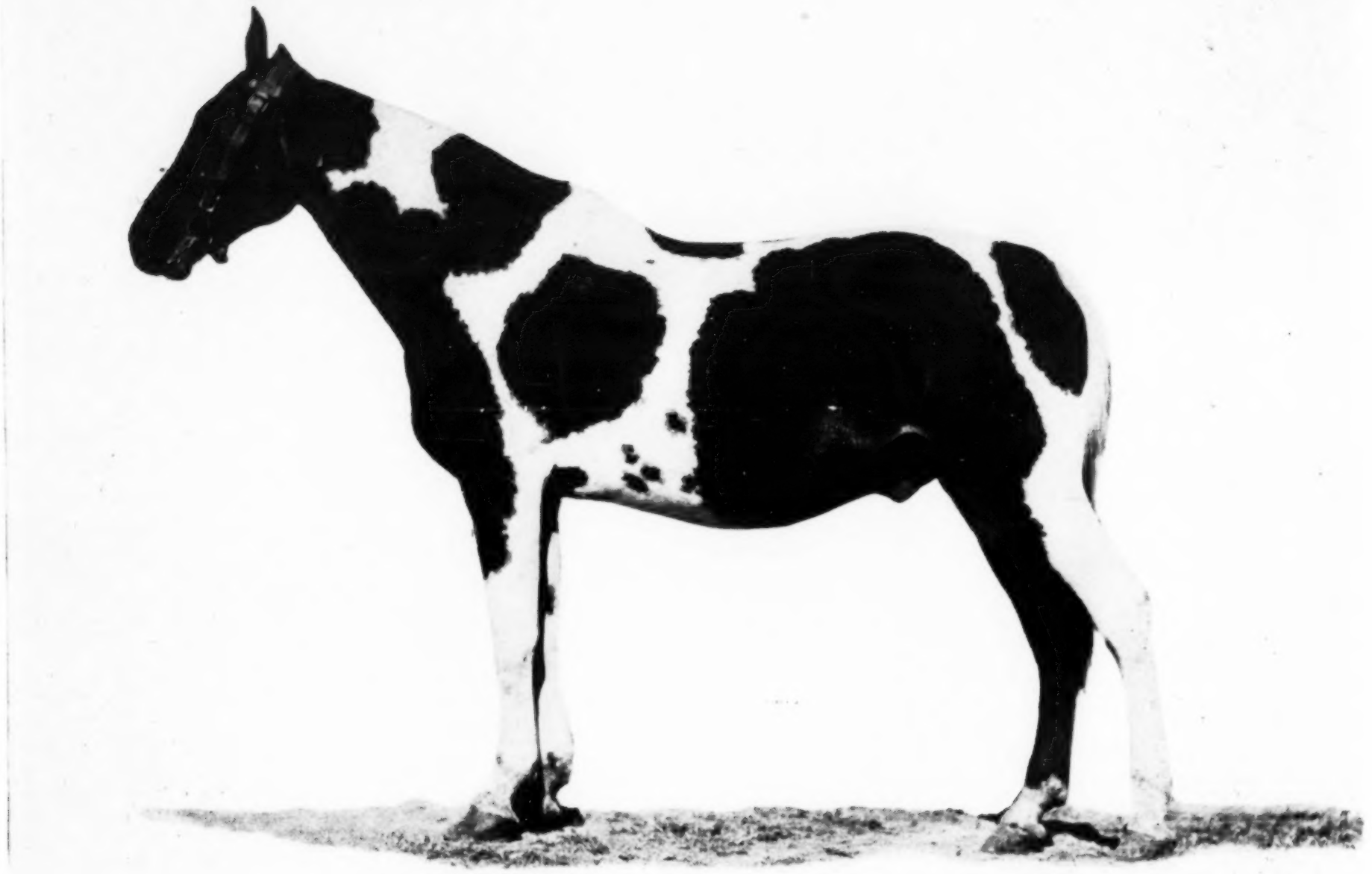
Although mongrel-bred, unsound and with apparently no points to commend him to the prospective breeder, this horse enjoyed an extensive patronage, due to his cheap fee, although pure-bred stallions were maintained in his district and were equally accessible. It is reported that he has been retired from service. The present crisis demands that every similar unsound animal be likewise replaced by sound stock for breeding purposes. Photograph from A. S. Alexander. (Fig. 15.)

breeders of the country have an opportunity to contribute to the welfare of the country. Animals must be produced for much of the work on the battlefields, since horses can make headway over shell holes where an auto truck is unable to go; and the availability of the economic resources of the nation will be dependent to a large degree on the accessibility of sufficient draft animals.

During the past three years, the Allies have not only utilized their own equine resources but have also made heavy drafts on American stock. Up to May 1, 1917, the entente had imported from this country 1,107,152 horses and mules, at prices ranging from $100 to $250. Since the number of horses in the United States is approximately 24,100,000, about 4.0% of the available horses have been purchased and about 6.0% of the available mules.

ALLIES DID NOT GET THE BEST

It has often been stated that the Allies have stripped the American market of all superior horses, so that few are left except those physically unfit for war work. Such is not the case. Data compiled by the Bureau of Animal Industry, U. S. Department of Agriculture, indicate that the Allies have purchased only average horses from the sound stock of the country and that facilities for breeding good stock are just as available as ever. There is certainly enough good stock in the country which is accessible to the breeder for producing the essential animals for use during the



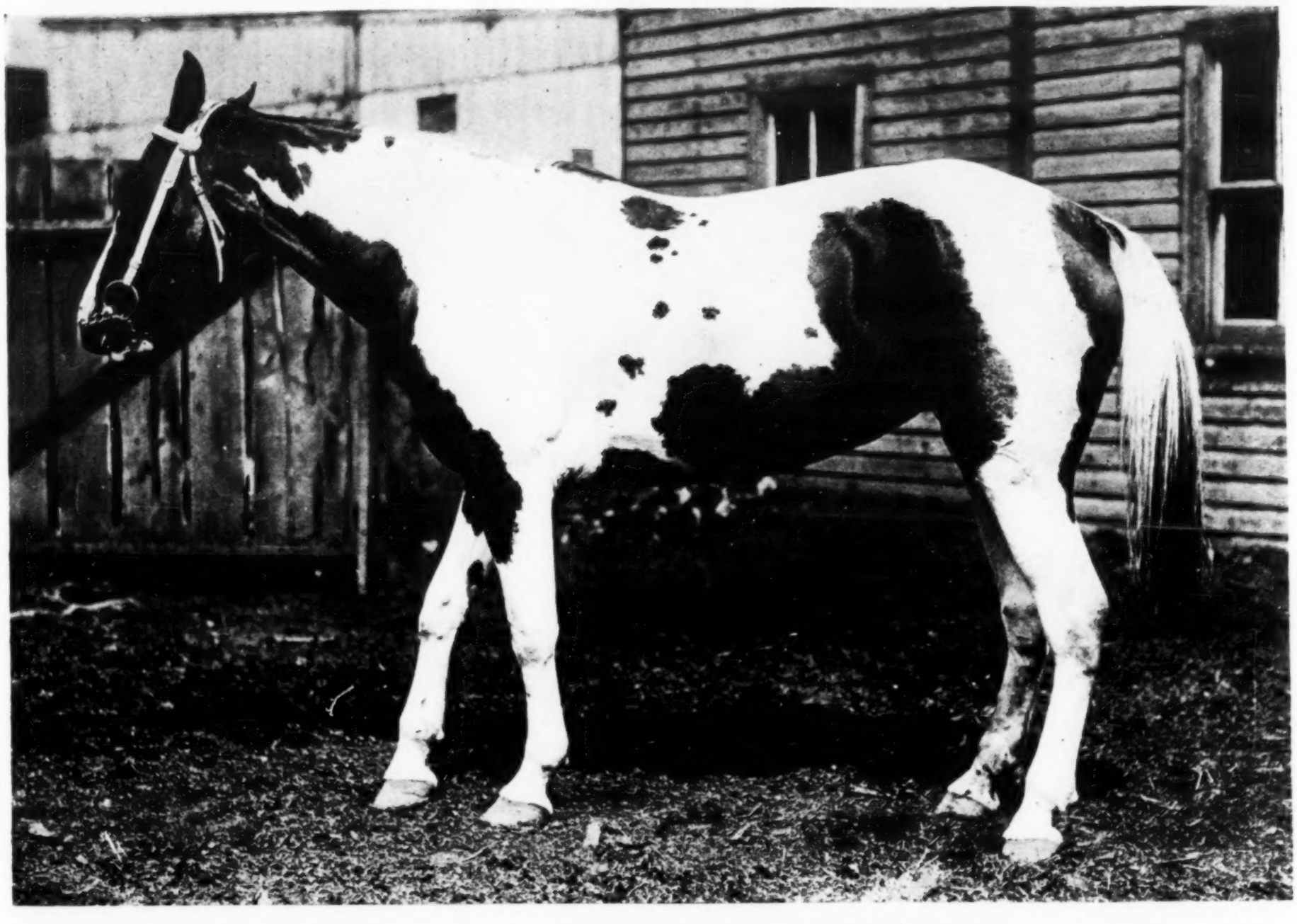
AN OBJECTIONABLE AND UNSOUND STALLION

The spots and undesirable conformation of the hind leg are the two most noticeable features of this stallion, who was supposed by the miraculous virtue of a tincture of pure blood somewhere in his ancestry to be able to stamp his offspring with the desirable traits of the breed with which he was supposed to be connected. As shown by the following two pictures, he proved to be as prepotent as the most optimistic had hoped, but not in quite the manner they had anticipated. Photograph from Bureau of Animal Industry. (Fig. 16.)

war and during the vast economic reconstruction which will follow, but there are also far too many unsound and mongrel animals which will be a drag on the industry as long as they are used for breeding. These ill-bred animals should be eliminated. The most important measure in this connection is to eliminate inferior stallions, since one stallion may transmit faults to the offspring of hundreds of mares.

The work of stallion licensing was first taken up in Wisconsin, where the method of operation can be advantageously studied. Although it may not seem at first sight that the mere act of licensing stallions would form a panacea for all breeding troubles, and turn out the perfect horses which are so essential in the scheme of war preparedness, nevertheless, it will be found upon further investigation that the license laws have played an important part in eliminating scrub sires.

In Europe, almost ideal breeding laws have prevailed for a long time. The French Government has for over a hundred years maintained stables of selected pure-bred stallions, and the owners of superior horses receive a bonus for keeping them in the country for service. In Belgium, the government used to spend large sums of money annually in prizes and appropriations to encourage horse breeding along the right lines. Similar conditions prevail in Germany, where prizes are offered for brood mares and stallions of unusual worth. Austria, England, and Scotland all have similar methods of encouraging prudent breeding and the results are self-evidently well worth the time



WHAT THE SPOTTED STALLION PRODUCED

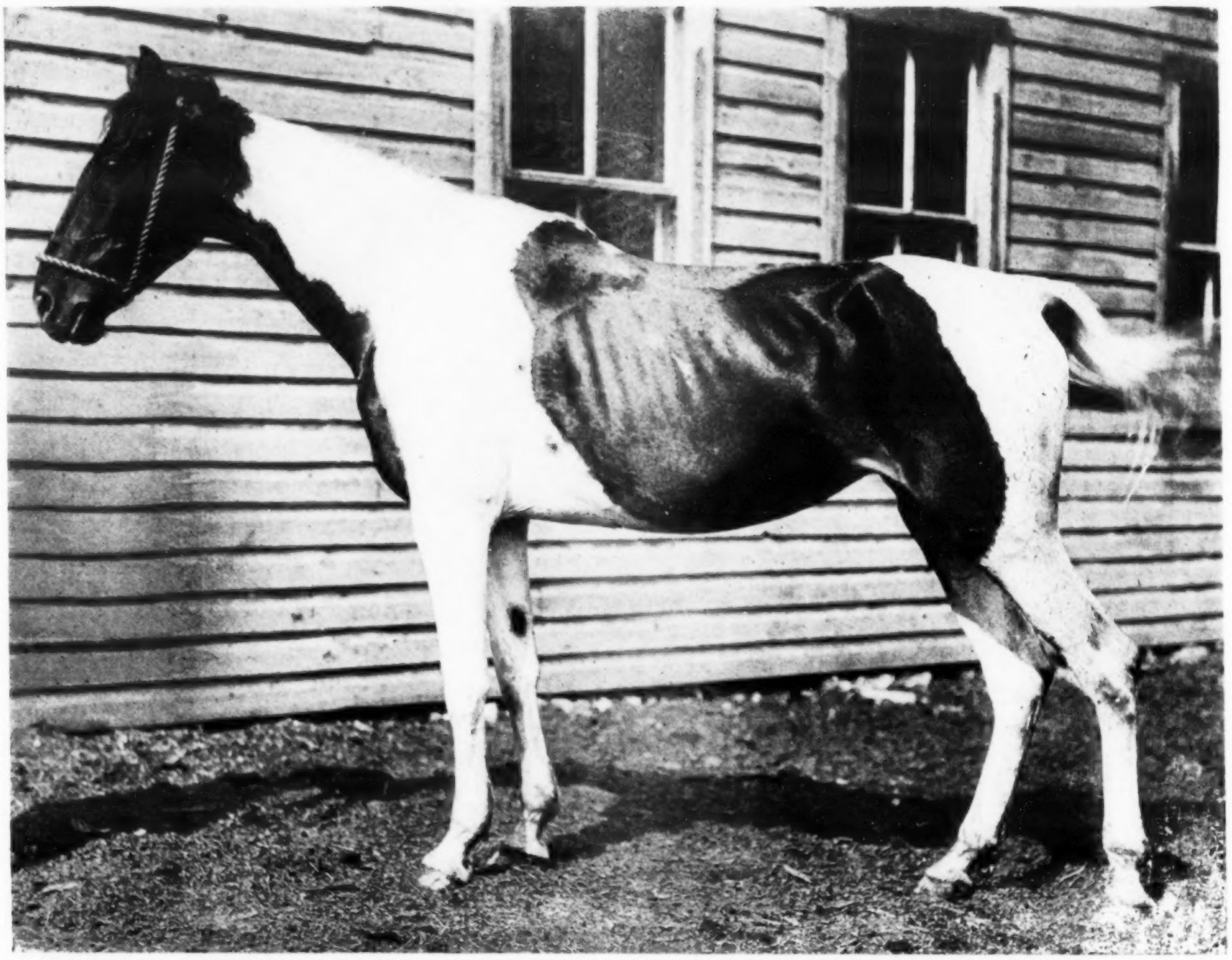
This mare was sired by the stallion shown in the preceding figure, and the curby conformation of the left hind leg is plainly noticeable. The piebald pattern itself, which is always transmitted by a stallion who possesses it to at least half his offspring, is no more conspicuous to a horseman than the inherited leg-conformation. Photograph from Bureau of Animal Industry. (Fig. 17.)

and money which has been spent in achieving them.

The progeny of a grade stallion from a mongrel mare is usually inferior in every way. The main reason for this is that the grade horse has not the prepotency to stamp the characteristics of the pure breed upon his offspring. One infusion of pure blood may be sufficient to make the first generation resemble markedly a given breed, but in the second generation, and often in the first, there is an overwhelming tendency for the large mass of mongrel ancestry to crop out, and hence the offspring may in no way resemble the breed which it is supposed to represent. When a pure-bred stallion is used, he is generally prepotent enough to stamp his offspring with the desired qualities, but the offspring when again bred with mongrel stock is rarely prepotent enough again to bring forth the desirable traits.

The only way by which the horse industry can be built up in this country along right lines is by grading. But this grading must be carried on by right methods, and should not include the use of grade stallions. It is obviously impossible to depend wholly on pure-bred stock, because only a small percentage of the animals in this country are pure-bred. This is especially true of brood mares, which, producing only one foal a year, would have to be available in enormous numbers in order to obviate the necessity of using mongrel or grade mares. Hence, it is easily evident that the grading system offers the only solution of the problem of building up the breed on the maternal side.

But on the paternal side the case is quite different. Since one stallion can serve successfully a hundred or more mares in one season, a comparatively



ANOTHER MARE FROM THE SAME STALLION

This mare might possibly be placed in the much-abused "general purpose" class, but she inherits the crooked hind legs of her sire, together with many of his other defects, and hence is of little real value. Photograph from Bureau of Animal Industry. (Fig. 18.)

small number of pure-bred stallions will suffice to carry on the grading-up process satisfactorily. The use of grade mares because of the non-availability of pure-breds is hence logical and satisfactory in the grading system, but the use of other than pure-bred stallions is inexcusable.

In work which was started some time ago by the Bureau of Animal Industry, pure-bred stallions of unusual worth were stationed in various districts, and service was furnished to owners of mares gratis. In return for the free service, the government obtained an option on the colt during its third year at a price of $150, or if the farmer wished to dispose of it elsewhere, he could be released from his contract by paying $25 as a service fee. Due to small appropriations for this work, it has not yet attained such proportions that a definite report on its success can be made.

Horses will be needed on the battlefield and on the farm; to haul the cannon and the plow. Good horses which can stand up under the demands of the economic crisis of the country can be produced just as cheaply as unfit animals with ewe necks, waspy waists, cat hams and starey coats. The cheap service fee will be lost in insignificance compared with the relative prices which will be paid for sound and unfit for horses; In the great agricultural preparedness of the country, the breeder of sound and fit horses has just as responsible a position as any "soldier the commissary." It is his duty to fulfil that responsibility by turning out through prudent breeding and by avoiding inferior stock as has been described, horses which can "do their bit."

INHERITANCE OF A BI-LOBED EAR

RICHARD SCHOFIELD

Department of Zoology, University of California

IN a family in which a bi-lobed ear has been transmitted through four generations, only the right ear shows the characteristic in question. The line of separation does not parallel the vertical axis of the body, but tends to follow the posterior margin of the ear. There is no regularity in its manifestation so far as generations are concerned, and it appears in either sex, and in both sexes in the same family. Its appearance is not constant, for it may skip one or even two generations and then be present.

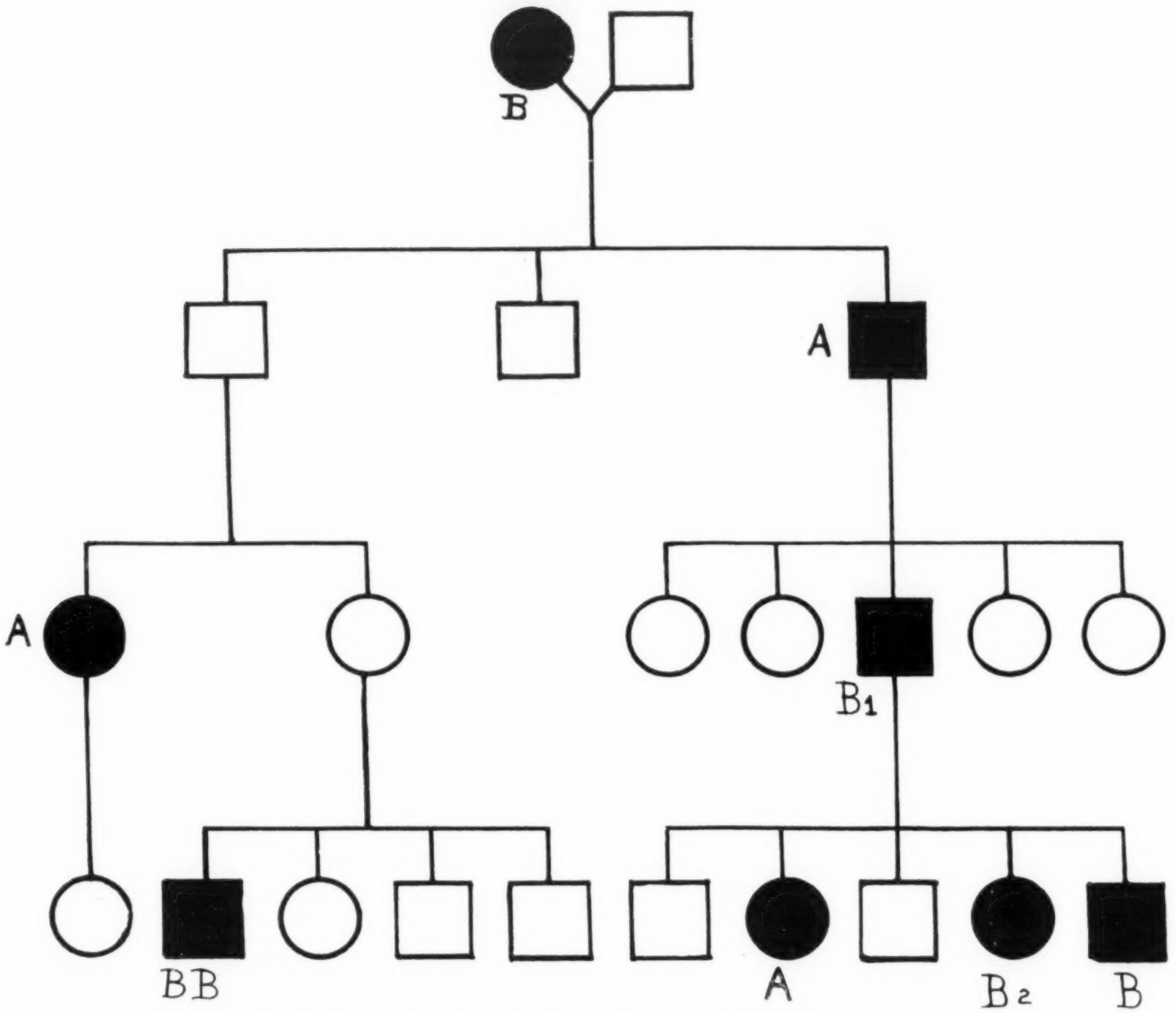
In the individuals designated in the chart by A there is a very marked deep cleft that is of considerable length, while in those marked by B the cleft is not so well marked, and in the case designated by BB it is so slight as to be nothing more than a furrow. In the individuals B1 and B2 there is a deficiency in hearing in the bi-lobed ear, while in the others there is no apparent deficiency of any kind. No information is obtainable as to when this strange anomaly was first noticed in the family, but in each individual affected the trait is as pronounced at birth as at any other time, and it does not increase with the age of the person. Each case charted has been seen by the writer except the female shown in the first generation. The cleft probably originated as a mutation, though nothing definite can be said in this regard; and from its mode of transmission it appears to be an imperfectly dominant trait.

In the JOURNAL OF HEREDITY, December, 1916, there appeared an article by A. E. Jenks, "Pitted Ear Lobes of Congenital Origin," in which a condition is described similar to the present case. The author evidently thinks that there is at least a possibility of the trait being the result of a mutation which first appeared three generations previous to the one he has described. The character, like the present one, appears to be transmitted as an imperfect dominant.

In the case at hand there is exhibited a variable inheritance which ranges from the deep cleft in one instance to the slight furrow in another individual. The imperfection of dominance may well be explained by the variability of the potency of determiners, or perhaps as the result of environmental factors.

OUTLINE OF EAR

Although every individual affected did not present quite the same characteristics, the above drawing shows graphically the striking division of the lobe. (Fig. 19.)



INHERITANCE CHART OF BI-LOBED EAR

The squares represent males, the circles females, affected individuals being designated in black. As may be seen, both sexes appear to be affected equally and indifferently. (Fig. 20.)

A Study of Bud Variations in Coleus

One of the most valuable recent contributions to the study of evolution is that of A. B. Stout, director of the laboratories of the New York Botanic Gardens (Carnegie Inst. Washington Pub. 218). He started with a single variety of Coleus, an ornamental plant much used for bedding and in pots for indoor display. This was propagated by cuttings and showed both gradual fluctuations and abrupt mutations, sixteen distinct and characteristically different color patterns being eventually produced. The results are interpreted by Dr. Stout to mean that slight variations, arising either suddenly or gradually, can perpetuate themselves, as Darwin supposed but as some recent biologists have denied. It is claimed that bud mutations in Coleus are common, result in numerous different types which may be vegetatively constant from the first or can be made so by selection, show development of certain types more commonly than others, produce reversions to parental types, give development of different degrees of variability among sister clons, and exhibit spontaneous changes in the fundamental color patterns and in the cellular and tissue patterns resulting in color patterns. Sexual and asexual reproduction are therefore believed to be not fundamentally different in respect to extent and range of variation.

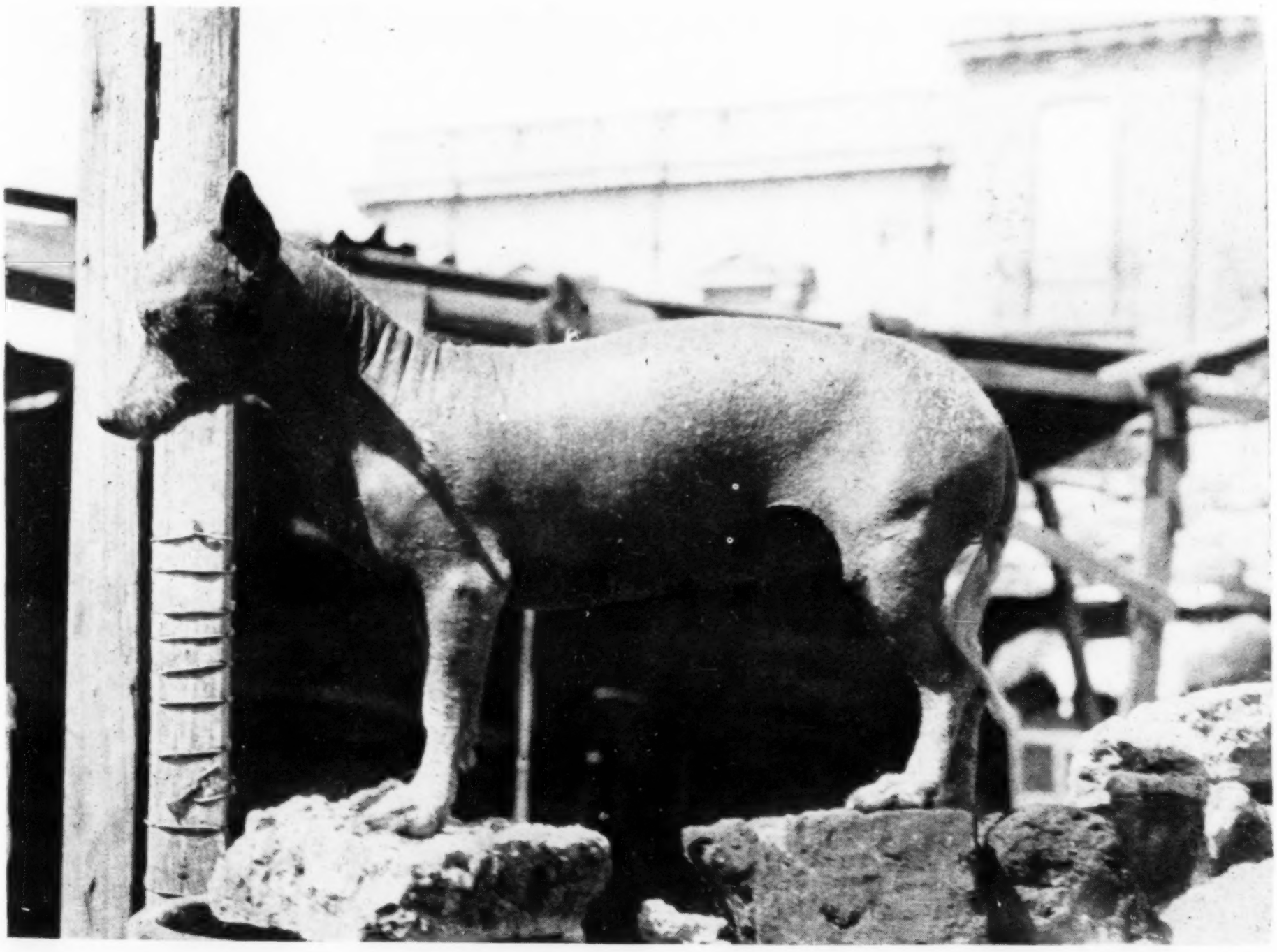
THE HAIRLESS DOG

FEW breeds of dog have received less attention from breeders than the hairless dog of Northern Mexico, sometimes called the Chihuahua dog. It is presumably descended from one of the Central American wolves. Fitzinger[1] considered it a distinct species, but without much evidence. The breed is comparatively rare even in Mexico.

The hairless condition is strictly an abnormal one, and is said to be associated with defective teeth. The dogs are extremely sensitive to changes of temperature, as well as to flies. To the touch they feel very warm, which may account for their reputation in Mexico for curing rheumatism.

The accompanying photographs are furnished by Arthur Stockdale of Mexico City, who writes that hairless dogs breed readily with normal dogs, and that half of the offspring are haired, half hairless. The sharp contrast between the two pups shown in the photograph indicates that the hairless condition may be a unit difference.

Fig. 1 shows the mother, a typical hairless dog. In Fig. 2 are two of her pups, litter brothers, sired by a mongrel dog who was normally haired.



A MEXICAN HAIRLESS DOG

This bitch, presenting all the typical characteristics of the hairless breed, was bred to a normal haired dog. Her pups are shown in the following picture. (Fig. 21.)

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[1] Fitzinger, L. J. Untersuchungen über die Abstammung des Hundes. *Sitzungsber, math.-nat. cl. K. Akad. Wiss.* liv., pp. 396–457. Wien, 1866. See also the same author, *ibid*, lvi, pp. 494–9, Die Rassen des zahmen Hundes.

HAIRLESS AND HAIRY PUPPIES FROM THE SAME LITTER

The pup on the left presents no similarity to the hairless breed, while the one on the right has every characteristic of the typical hairless dog. This would seem to indicate that hairlessness is a unit characteristic. (Fig. 22.)

A Handbook of Mendelism for Live-stock Breeders

DIE BEDEUTUNG DES MENDELISMUS FUR DIE LANDWIRTSCHAFTLICHE TIERZUCHT, von J. H. W. Th. Reimers. Pp. 105. 'S-Gravenhage, Martinus Nijhoff. 1916.

No clearer and sounder discussion of the application of Mendelism in animal-breeding exists than this booklet of Professor Reimers, editor of the *Veldpost*, the greatest agricultural journal of Holland, and instructor in the agricultural school at Utrecht. After a full explanation of the Mendelian laws, he discusses their limitations, fully recognizing that they are not of great importance so far to the practical breeder. He then outlines a method of selection on the basis of the animals' performance as breeders, which is in accord with the theory of genetics.

COLOR INHERITANCE IN MAMMALS

VI, Cattle—Explanation of Reds, Roans, Whites in Short-horns Long a Matter of Dispute—Analysis Shows That Only a Single Pair of Mendelian Factors Can Be Involved aside from Minor Variations—Colors in General Determined by Combination of Independent Sets of Allelomorphs and not by Polygamous Factors—Dun the Dilute Form of Black

SEWALL WRIGHT
Bureau of Animal Industry, Washington, D. C.

BLACK COW—WVDME

$1a_1$	W, w	Ww—roan, WW—white
$1a_2$	V, v	V—pied
$1a_3$	—	
1b	D, d	D—dun
	M, m	eeMM—mahogany (sex limited).
$1a_1$	—	
$2a_2$	E, e	ee—red
$2a_3$	—	Unanalyzed factors for brindle.
2b	—	

FACTOR COMBINATIONS

	ww	Ww	WW
DE....	dun	dun roan	white(dun ears)
Dee ...	yellow	yellow roan	white(yellow ears)
ddE ...	black	blue roan	white(black ears)
ddee ...	red	red roan	white(red ears)

Classification explained in paper on the Mouse, JOURNAL OF HEREDITY, 8:373. August, 1917.

THE first colors in cattle to receive attention from geneticists were the whites, roans and reds of Shorthorns. Barrington and Pearson[1] made a study of Shorthorn herdbooks in 1906 with conclusions adverse to Mendelian inheritance. Wilson,[2] however, soon pointed out how closely the general facts fitted with the hypothesis that roan is the heterozygote between red and white. Since then many investigations have been made on the question with essentially similar results. There is a general harmony with unit factor inheritance, but also a small per cent of well authenticated discrepancies with theory, even after allowing for the known inaccuracy of herd books. The summary by Wentworth[3] given at the bottom of this page illustrates the case well. The last column gives the expected number of young from each kind of mating, if mating were wholly random as regards color.

UNIT, NOT MULTIPLE FACTORS

Various multiple factor hypotheses have been devise to meet the situation. Laughlin[4] advanced an hypothesis involving four pairs of factors and two physiologically distinct groups of hairs scattered over the body. By this means any particular case that might

	Red	*Roan*	*White*	*Total*	*Expected*
Red × red	1,710	102	39	1,851	1,998
Red × roan	1,763	1,336	15	3,114	3,620
Red × white	20	891	18	929	724
Roan × roan	664	1275	471	2,410	1,642
Roan × white	8	168	72	248	657
White × white	4	8	141	153	64
	4,169	3,780	756	8,705	8,705
	47.9%	43.4%	8.7%		

[1] Pearson, K. and Barrington, A. 1906. *Biom.*, 4:427.
[2] Wilson, J. 1908. *Sci. Proc. Roy. Dub. Soc.*, 11.
[3] Wentworth, E. N. 1913. *Amer. Breed. Mag*, 4: 202–208.
[4] Laughlin, H. H. 1912. *Amer. Nat.* 45:705.

arise could be explained. Unfortunately the general facts become inexplicable on this view. Wentworth advanced a more easily tested hypothesis; viz., that there are separate factors for roan and white. Factor P for roan is considered dominant over p for red and factor R for color is dominant over r for white.

	PP	Pp	pp
RR.....	roan	roan	red
Rr.....	roan	roan	red
rr.....	white	white	white

This view also, however, may be shown to account for the discrepancies from the simple one-factor hypothesis at the expense of the general facts. An analysis of Wentworth's data on the assumption that cattle breeders pay little attention to color gives some interesting results. From comparison of the total number of young from each kind of mating in the data above with the number expected on random mating (column "expected") the degree to which mating is preferential in regard to color may be estimated. The expected number of young from each kind of mating has been calculated on the assumption that the Shorthorn population is in equilibrium as regards color and that matings actually are by chance in this respect. Thus with 47.9% of the animals red, .479 × .479 of the matings should be red by red giving an expected number of calves of 1998, where the actual number was 1851. The table indicates a distinct excess of matings of roan by roan and white by white. Roan by white and roan by red seem to be most discriminated against. On the whole the assumption of random mating should give sufficiently accurate results for the present purpose.

Red is rather more common than roan which means that factor p is more common than P. Thus most whites should be of formula pprr or Pprr and very few PPrr in a population breeding at random. Thus whites crossed with reds (pp) should produce more reds than roans which is very far from the case. On the basis of equilibrium, it is easy to calculate the expected proportions of each genetic formula in the population and hence the proportion of each color of young in any cross. The per cent of whites (rr) is 8.7. The relative proportions of heterozygous and homozygous colored (Rr and RR) must be such that the number of heterozygotes is twice the product of the square roots of the number of the two homozygous classes by the well-known formula for a Mendelian population in equilibrium. This gives 41.6% heterozygous colored and 49.7% homozygous colored. By excluding from consideration the whites, in which the distinction between roan and red is considered to be hidden, the per cents of homozygous roans, heterozygous roans and reds can be calculated in a similar manner. By multiplying together these two sets of calculations, the per cents of each of the nine combinations of factors can be found. Thus with 49.7% homozygous colored (RR) and 40.0% heterozygous roan (Pp), the product, 19.9%, is the proportion of roans of formula RRPp. The tables below summarize the results:

Formula	%	
RR	49.7	70.5%—per cent of R's in the population.
Rr	41.6	29.5%—per cent of r's in the population.
rr	8.7	
	100.0	
PP	7.6	27.6%—per cent of P's in the population.
Pp	40.0	72.4%—per cent of p's in the population.
pp	52.4	
	100.0	

PER CENT OF FACTOR COMBINATIONS

	PP	Pp	pp	
RR.....	3.8	19.9	26.1	49.8
Rr.....	3.2	16.6	21.8	41.6
rr.....	0.7	3.5	4.6	8.8
	7.7	40.0	52.5	100.2

From these data we can make up all kinds of matings and calculate the per cent of each color, which should be produced. The matings red by white and roan by roan are most significant. Allowing for the proportion of the four kinds of roans, two kinds of reds and

three kinds of whites, the following per cents of red, roan and white offspring are expected. The percentages expected in the simple one factor hypotheses that roan is the heterozygote between red and white are also given and finally, the per cents actually found as given in Wentworth's data quoted above.

Parents red × white	% Red	% Roan	% White
By two factor hypothesis.	55.9	21.3	22.8
By one factor hypothesis.	0.0	100.0	0.0
Actually found.....	2.2	95.9	1.9

Parents roan × roan	% Red	% Roan	% White
By two factor hypothesis.	16.7	78.1	5.2
By one factor hypothesis.	25.0	50.0	25.0
Actually found.....	26.6	52.9	19.5

The striking fact that in a population breeding nearly at random, roan by roan produces little more than 50% roan, the rest being divided between red and white, while red by white produces about 96% roan, can hardly be accounted for on any theory of inheritance other than a single main Mendelian factor without dominance. The exceptions must be accounted for on hypotheses subsidiary to this, as is done by Wilson and by Walther.[5] The two factor hypothesis gives expectations far removed from the actual results and the writer can devise no other hypothesis involving multiple factors of anything like equal influence which is appreciably better. Finally, an additional test may be noted which the one factor hypothesis meets quite successfully. With 756 whites (WW) and 4,169 reds (ww) in a population in which there is random mating, the number of roans (Ww) should be twice the square root of the product, or 3,551. The actual number 3,780 is as close as can be expected, considering the departures from random mating in the present data.

VARIATIONS OF ROAN

As for the discrepancies, part are known to be due to errors in the herd books. A clue to the remainder is seen in a consideration of other breeds which show the nearly solid white condition.

An excellent review of the subject has recently been written by Lloyd-Jones and Evvard.[6] The famous Chillingham cattle are white with dark points. They occasionally throw black or dun colored calves. Here white is clearly dominant. A very similar white with dark points crops out from time to time in Pembroke and in Highland cattle, although constantly selected against. Here as Lloyd-Jones and Evvard point out white is clearly recessive. Thus we have whites of very similar appearance which are respectively recessive, dominant or neither in Pembroke, Park cattle and Shorthorns. Is it necessary to suppose that three independent factors are involved? The simplest explanation seems to be that there is a continuous series of physiological conditions between a very strong self tendency through roan to a very strong white tendency. The level in this series possessed by a particular group of epidermal cells of any animal is determined perhaps by many factors, some merely developmental (making it possible for adjacent hairs to have different potencies and so produce the roan effect) and some hereditary. Among the hereditary factors, two hypotheses are at present equally possible. There may be one Mendelian pair (W,w of this paper) which stands out in the importance of the effect but which, nevertheless, cooperates with lesser factors which determine the general level in the series; or there may be a series of allelomorphs such that a more potent white factor is dominant over a self factor which is just below the roan level and *vice versa*. The two hypotheses would give very different results but there seem to be no data at present by which they may be distinguished.

This roan factor quite certainly belongs in class $1a_1$ in spite of its variable dominance. It is a factor which determines an inhibitor of color regardless of the quality of the color. The truth of

[5] Walther, Ad. 1913. *Zeit. f. Abst. u. Ver.*, 10:1–48.
[6] Lloyd-Jones O. and Evvard. 1916. *Res. Bull. No.* 30, *Ag. Exp. Sta.*, Iowa State Coll. Agr.

this statement is at once apparent on considering the results of crossing Shorthorns which are white with red points with self black Galloways or Angus cattle. These very common crosses produce blue roan calves. The white pattern is the same as in Shorthorn roans though the color is changed.

As to the genetic relations between black, red and white, two views are held. Wilson[7] has argued that black, red and white as well as most other cattle colors belong to the same series of allelomorphs or "polygamous factors." His scheme is as follows:

BB —black		
BR —black	RR —red	
BW—blue roan	RW—red roan	WW—white

On this hypothesis no blue roan (BW) should be able to transmit red. This should be possible on the hypothesis of independent factors as given under "Factor Combination" at the head of this article. Lloyd-Jones and Evvard report on the cross of white and red roan Shorthorns with black Galloways. F_1 consisted mainly of blue roans (from white sire) or blue roan and blacks (from red roan sire). The blue roans in F_1 must be BW on Wilson's hypothesis, EeWw on the hypothesis of independence. In F_2, twenty-six calves were obtained of which six were reds of some sort (four solid red, one red and white, one red roan). This result obtained under experimental conditions seems thoroughly sufficient to establish the hypothesis of independence, and even the absence of appreciable coupling between E and W. Furthermore, the production of whites with black ears and muzzles (presumably EeWW) but which on Wilson's hypothesis must be identical in formula with the red-eared white ancestor is pretty conclusive as to independence of the white pattern and the quality of the pigment it inhibits.

PIEBALD PATTERNS

Piebald patterns, running from a bit of white on the switch or underline as in some Galloways to a nearly black-eyed white condition as in some Ayrshires, are very common in cattle. It is generally agreed that this white is inherited independently of the character of the ground color and can be transmitted from a red breed to a black one and *vice versa*. The white-faced black calves that result from crossing the white-faced red Herefords with the solid black Angus are familiar examples. Boyd[8] has shown that Hereford by bison produces white-faced hybrids usually black or dark brindle. As regards the mode of inheritance, however, there is little which can be considered established. The cross cited above indicates at least partial dominance but, of course, does not prove unit Mendelian inheritance. In Shorthorns, neither Wilson nor Wentworth could find any simple mode of inheritance, solid red by solid red might produce red and white piebalds and *vice versa*. Lang[9] cites crosses made by Kiesel in which the self colored Limburger race was crossed with a piebald German breed. F_1 was intermediate piebald. The back cross with the self breed produced 22 self, 29 piebald. The back cross with the piebald race produced 84 out of 90 piebald. The case is probably similar to that of piebald in most other mammals, heterozygote intermediate and much variation which is not genetic.

One of the most interesting things in connection with the pied cattle is the number of sharply distinct patterns which have become fixed. There is the white face of the Hereford, the white belt of the Dutch and the irregular pied pattern of Holsteins, Ayrshires and other breeds. Are these to be looked upon as entirely independent of each other genetically and physiologically or have they a common element? In guinea-pigs all of these patterns and many others may crop out even in the same litter in a stock in which the total amount of white is relatively constant. MacCurdy and Castle[10] have shown, however, that a tendency toward one

[7] Wilson, J. 1916. A Manual of Mendelism. 152 pp.
[8] Boyd, M. M. 1908. *Amer. Breed Ass. Rep.*, 4:324–331.
[9] Lang, A. 1914. *Experimentelle Verebungslehre*, 467–888.
[10] MacCurdy, H. and Castle, W. E. 1907. *Carn. Inst. Wash. Pub.* 70, 50 pp.

type of pattern can be produced by selection. The conditions strongly suggest that the pattern is the resultant of two very different kinds of factors, factors which determine a certain general level of some essential for pigment production and factors which affect the course of development so as to bring out particular lines of weakness in which the pattern of white shall appear if the general level is low enough. On this view a Hereford, a Dutch-belted cow and a Holstein might possess the identical piebald factor as regards quantity but differ in hereditary factors which determine the type of regional differentiation. As far as the writer knows no Mendelian differences of this second kind yet have been demonstrated in any mammal.

Spillman[11] early showed that red is a simple recessive to black. Red calves appear from time to time in purebred Angus and Galloway cattle which are nearly fixed for black. In crosses discussed by Jones and Evvard, red Shorthorn by black Galloway produced black in F_1 with a few exceptions, while red segregated out in the expected ratio in F_2.

INTERGRADES BETWEEN BLACK AND RED

Several types of apparent intergrades between red or yellow and black are known. These are the brindles, duns and dark mahogany browns. In the brindles, however, there may be any ground color according to Wilson, red, yellow, dun or even black. The brindling consists in irregular streaks of black (or especially dense black if the ground color is black). In duns the coat is largely of a dull brownish black, the hairs showing a yellowish tip and the yellow color tending to predominate especially along the mid-dorsal line. The mahogany brown as in some Ayrshires may look almost black but appears to be simply a very intense red.

The most extensive investigation of brindle and dun has been made by Wilson[12] in a study of Highland herd books. Black, dun, brown, red, yellow, light dun and brindles are recorded. Occasionally whites appear as has been discussed. The palest yellows appear to be registered as light duns although free from the black of the true duns. As has been noted, Wilson explained the results by a system of multiple allelomorphs. He considers each of factors B, R, L, Br and W to be a Mendelian alternative of any other:

BB	black								
BR	black	RR	red						
BL	dun	RL	yellow	LL	light dun				
RBr	dark brindle	BBr	red brindle	LBr	dun brindle	BrBr	brown		
BW	blue roan	RW	red roan	LW	.....	BrW	.....	WW	white

Reasons have already been given for separating the factor for white from this series, as far as black and red are concerned. As regards brindle, the very fact that it can be visibly combined with any color suggests that it is as independent in inheritance as piebald. Brindle evidently means so many different things in Highland cattle that little can be learned from the data. In Wilson's tables brindle by brindle produces only about 50% brindles which may perhaps be taken as indicating its usual heterozygous nature. Brindle by red gives only about 23% brindles, 67% reds and a few others which shows that it cannot be due to a simple dominant if it is recorded at all accurately. The larger part of the brindles have at least one brindle parent but this is far from invariable. On the whole brindle can better be fitted as dominant than recessive but further study is necessary before any form of Mendelian inheritance can be considered established. For the present it seems safest to separate brindle from the other factors, as due to unanalyzed factors of class $2a_3$ which determine an increase in the density of black in irregular streaks on any ground. The fact that brindle by red gives only 4% black shows that brindle in the records generally means red brindle as might be expected and that factor e, not E, is present. Probably black brindles are usually simply called black.

[11] Spillman, W. J. 1907. *Sci. N. S.*, 23:545.
[12] Wilson, J. 1909. *Sci. Proc. Roy. Dub. Soc.*, 12–66.

More definite conclusions can be reached in regard to dun. The following table, which is a slight modification of Wilson's table for herd book 2 of the Highland cattle, shows some very interesting points. The progeny of each color are tabulated by per cent of the total, the total numbers being given in the last column for reference.

		Black	*Dun*	*Red*	*Yellow*	*Brindle*	*Number*
Black	× black	71	5	18	1	5	97
	× dun	29	45	11	13	1	82
	× red	43	4	43	4	7	239
	× yellow	27	24	16	29	3	74
	× brindle	45	2	29	2	22	181
Dun	× dun	(6)	0	0	(6)	(88)	(16)
	× red	18	13	23	46	0	54
	× yellow	2	53	11	30	5	64
	× brindle	18	32	9	18	22	87
Red	× red	3	1	86	9	2	131
	× yellow	5	2	46	35	12	121
	× brindle	4	0	67	6	23	188
Yellow	× yellow	5	2	46	35	12	73
	× brindle	3	4	22	49	23	111
Brindle	× brindle	13	0	35	2	50	80

A consideration of this table certainly justifies Wilson's contention that duns contain the factor by which blacks differ from reds. The crosses involving only red, yellow and brindle produce very few blacks and duns, probably no more than can be accounted for by errors in the records. The cross of black with black produces 71% blacks, not much below the 75% expected if blacks are heterozygous (Ee) which should generally be the case in Highland cattle. Black by red or brindle produces but little less than the expected 50%. But in the crosses of black by dun or yellow only 29% and 27% black calves are produced which shows clearly that factor E must be present in some other color than black. This color can only be dun (except perhaps for an occasional black brindle). Combining blacks and duns as mostly of formula Ee and reds, yellow, and brindles as mostly ee, the agreement between figures and expectation becomes fairly good.

It is further evident from the table that dun and yellow are closely related in some way. Black by yellow produces many duns (24%) and dun by red produces many yellows (46%) while neither color is produced in reliable numbers unless at least one parent is either dun or yellow. Wilson explains this by assuming that dun and yellow are respectively the heterozygotes of black and red with the rather uncommon cream-colored light dun which he puts in the same series as black and red. As an alternative hypothesis we may suppose that dun and yellow differ from black and red respectively by an independent dominant dilution factor of class 1b.

(1) Triple allelomorphs

BB black
BR black RR red
BL dun RL yellow LL light dun

(2) Two factor hypothesis

	DD	Dd	dd
EE	cream dun	dun	black
Ee	cream dun	dun	black
ee	cream (light dun)	yellow	red

Probably the best criterion between the two hypotheses which is present in the data is in the results of the cross dun by red. On Wilson's view (1) this should produce only blacks and yellows (BL × RR = BR + RL). On hypothesis (2), duns, blacks, yellows and reds should all be produced (EeDd×eedd= EeDd+Eedd+eeDd+eedd). The results, 7 duns, 10 blacks, 25 yellows and 12 reds point strongly toward the hypothesis of independence, although the excess of yellows and reds indicates that some of the parents called duns were probably really yellows lacking factor E. The color called light dun appears generally to be extreme dilution of red. It produces very few blacks and duns unless crossed with these varieties. The evidence for a unit Mendelian difference between red and light dun with yellow as the heterozygote is not as clear cut as could be

wished but the same considerations which apply in the case of roan shorthorns apply here. Yellow by yellow seems to produce distinctly fewer yellows than does red by light dun. No doubt subsidiary factors must be assumed to produce overlapping of class ranges. Following are some figures given by Wilson. The yellow by yellow data are from herdbooks 13, 14, 15; the red by light dun from books 3 and 15.

	Red	*Brindle*	*Yellow*	*Light dun*	*Dun*	*Black*
Yellow by yellow.....	15	5	40	8	5	1
Red by light dun.....	4	0	25	3	1	1

The factor D by which dun and yellow differ from black and red respectively fits best into class 1b and may be compared with the dun factor of horses. Dun cattle it is true appear to differ from blacks not only by dilution of color but by increase in yellow, but even blacks often show a red rustiness at the tip of the hair which suggests that they have been selected from a type with a pattern comparable to the agouti of rodents. In the general dilution of color brought about by factor D, the reduction in density of black permits the agouti pattern to become more visible. There is probably no color in cattle which can be compared with the recessive blacks among rodents. The blacks in cattle find their best homologue in the gray mice blackened by the black and tan factor, or in the black rabbits due to the addition of Punnett's density factor to grays.

Whether the colors which appear similar in the different breeds of cattle are really so genetically could only be determined by careful experiments. Judging by appearances it is probable that the dun dilution factor of Highland cattle is found also in the Guernseys and Jerseys. The former appear to be eeDD and most of the latter EEDD. Kuhlman[13] reports on the cross of Jersey with black Angus. F_1 was black or very dark dun. In F_2 black, dark dun and orange fawn appeared. The general level of intensity appears to be higher here than in Highland cattle.

Probably there are variations in intensity which do not belong to the series discussed. Wentworth[14] has reported on a very interesting factor in the dark mahogany colored Ayrshires. He finds clear evidence of sex-limited inheritance. Heterozygous males are dark colored while heterozygous females are like ordinary reds.

War Causes Increase in Illegitimacy in Europe

Almost every country in Europe shows a slight increase in the relative number of illegitimate births since the outbreak of the war, according to Emma O. Lundberg of the Children's Bureau, in an address before the National Conference of Social Work. In England and Wales, for instance, between 1913 and 1916 the total number of births decreased 10.8% while the number of illegitimate births decreased only 0.2%. In Berlin, however, the number of illegitimate births in the first fourteen war months was 29% less than in a similar period before the war. France and Italy show some increase. At the same time, all the warring nations are making better provision for the protection and welfare of the illegitimate child, thus reducing the high death rate in this class of infants. As illegitimate children probably represent, on the average, an inferior sexual selection on the part of their parents, the effect of the war in increasing the gross and net illegitimate birth rate is distinctly dysgenic. Miss Lundberg believes that the war is not likely to produce an increase of illegitimacy in the United States.

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[13] Kulhman, A. H. 1915. *Jour. Her.*, 6:68–72.
[14] Wentworth, E. N. 1916. *Jour. Ag. Res.*, 6:141–147.

Correction

In the October number of this journal, under the caption "The Too-perfect Milkweed," was published a photograph of the adaptation for cross-fertilization of the common milkweed. The story and legend under this photograph are entirely misleading. They were written by an amateur, and found their way into the journal owing to the fact that the editor has been drafted into military service. It is a familiar fact to students of botany that the flower base of the milkweed has no sticky substance on it but is furnished with remarkable perpendicular slits or openings larger below than they are above. As the insect alights on the flower, one or more of its feet slip into these slits and as it attempts to fly away, its claws slip upward in these slits and the hairs on its legs are caught and held tightly by a peculiar tough connecting contrivance like a clothes-pin, which holds the pollen masses or "pollinidia" together. These masses, produced in pockets one on either side of each slit, are normally pulled out by the insect as it flies away, and in drying they fold together like a book and are dragged by the insect into another flower, through one of the slits in its flower base. As directly underneath each slit the receptive stigmatic surface is located, the folded pollen masses are dragged over it and left sticking to it, where the pollen grains which compose the masses germinate and fertilize the flower. The trap occasionally fails to work and obliges the insect to depart without its legs, as is shown in the photograph. Weak insects are sometimes caught and die on the flowers.

Another error, on page 436, should be corrected. Captain Eben Putnam writes that his letter with regard to the draft of Old Americans in the New England states was written *before* the draft and merely declared that *if* certain conditions prevailed every citizen would be needed in some districts to fill quotas based upon enrollment.

DAVID FAIRCHILD

Annual Meeting of the Eugenics Research Association

Dr. Henry E. Crampton, of Barnard College and the American Museum of Natural History, New York City, was elected president of the Eugenics Research Association at its annual meeting last month. H. H. Laughlin was elected secretary-treasurer, and Mrs. Winifred Hathaway and A. H. Estabrook were chosen as members of the council, the latter to succeed himself. Four scientific committees were provided for, as follows:

1. Committee on Personality Study: Dr. Adolf Meyer, Dr. August Hoch, Dr. G. S. Amsden, Dr. D. W. LaRue.
2. Committee on Inheritance of Mental Traits: Dr. Robert M. Yerkes, Dr. John B. Watson, Dr. C. B. Davenport.
3. Committee on Practical Application of Eugenics with Special Reference to the Mores: Dr. Irving Fisher, Dr. H. F. Osborn, Dr. Katherine B. Davis.
4. Committee on Eugenics and War: not yet appointed.

Mental Survey of a Workhouse Population

The entire population of a workhouse (132 men) in an Ohio city of 200,000 population was tested by Rudolf Pintner and Herbert A. Toops of Ohio State University. "For the purpose of a rough mental survey," they report, "this picture of the mentality of the group is no doubt characteristic. The population of this workhouse is made up of a few men of perfectly normal mentality, and of three other groups of about equal numbers, one of which may be characterized as slow, another as very retarded mentally but not sufficiently so as to be considered mentally incapable, and the third as definitely feeble-minded or mentally incompetent. It is surely significant that no case tested above normal." The investigation is reported in the *Journal of Delinquency*, September, 1917.

Genetics Literature

THE annual reports of the AMERICAN BREEDERS' ASSOCIATION, published in seven volumes, form the most valuable collection of material for students of genetics which has been published in the United States. Most of them are out of print and are becoming expensive. All of them are nearly indispensable to libraries, institutions and students of plant and animal breeding, heredity, variation, eugenics, or genetics in general.

The Association still has on hand a limited number of copies of three of these reports, which it offers for sale.

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As the Association frequently receives requests for other volumes of the proceedings, which are now out of print, it will be glad to hear from those who have copies for sale or exchange.

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Vol. II, Nos. 3 and 4.
Vol. III, No. 2.
Vol. IV, Nos. 1 and 4.

JOURNAL OF HEREDITY:

Vol. V, Nos. 5, 6, 8, 9, 10, 11 and 12.
Vol. VI, Nos. 2, 3, 7, 9, 11 and 12.
Vol. VII, Nos. 3, 5, 6, 7, 8, 9, 10, 11 and 12.

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